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Personality, Behavioral Strengths and Difficulties and Performance of Adolescents with High Achievements in Science, Literature, Art and Sports

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Personality, Behavioral strengths and difficulties and performance of adolescents with high achievements in science, literature, art and sports

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ABSTRACT

Individual variation in personality is related to differences in behavioral difficulties and achievement in unselected samples, and in samples selected for high achievement in various domains. This is the first study to explore and compare the connections between self-report measures of personality (Big Five and Dark Triad), behavioral strengths and difficulties, and school achievement in four tracks of high-achieving adolescents ($N = 1179$) selected based on their exceptional performance in: *Science, Arts, Sports and Literature*. Personality was more strongly related to behavioral strengths and difficulties than to achievement in all tracks. As such, personality traits may be indirectly linked with achievement via behavioral strengths and difficulties. For example, narcissism correlated negatively with behavioral difficulties but did not significantly correlate with achievement. However, achievement was correlated negatively with behavioral difficulties. Network analyses indicated that teacher-awarded grades, but not anonymous exam grades, were weakly connected with personality. Specifically, teachers awarded higher grades to students with more 'desirable' personality traits such as high agreeableness. Results also showed track differences in the networks of personality, behavior and achievement. These findings are discussed in the context of personality as a resilience factor against behavioural difficulties and as a contributor to school achievement in gifted adolescents.

1. Introduction

There is a growing interest in studying the role of personality traits in academic achievement and psychopathology in unselected samples (Carragher et al., 2015; Dumfart & Neubauer, 2016; Papageor-

giou et al., 2018; K. A. Papageorgiou, Denovan & Dagnall, 2019), as well as in samples selected for high performance in various domains (Eklund, Tanner, Stoll & Anway, 2015; Lee, An & Choe, 2019; Mammadov, Cross & Ward, 2018; Rinn & Majority, 2018; Vötter & Schnell, 2019; Wirthwein, Bergold, Preckel & Steinmayr, 2019).

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Accumulating evidence suggests that personality traits associate with achievement through various pathways (Poropat, 2009). For example, research indicates that individual differences in personality traits indirectly contribute to individual variation in academic performance and learning by facilitating the use of cognitive traits, such as intelligence (Rindermann & Neubauer, 2001). The most consistent results in this line of research have derived from studies on the Big Five personality traits, which asserts that individual differences in normal behavior can be classified in terms of five independent dimensions: Agreeableness, Conscientiousness, Extraversion, Neuroticism and Openness to Experience (Furnham, Mosen & Ahmetoglu, 2009).

Most studies, including meta-analyses, have identified Conscientiousness as the strongest (out of the five traits) predictor of academic achievement in unselected samples (Noftle & Robins, 2007; Poropat, 2009). Conscientiousness is moderately, positively and consistently correlated with various academic outcomes including performance in exams, essays, continuous assessment and supervised dissertations (Furnham et al., 2009; O'Connor & Paunonen, 2007). Openness to experience and Agreeableness have also been linked to academic achievement, with small effect sizes, whereas the findings on the association between Neuroticism and Extraversion with achievement are not conclusive (De Feyter, Caers, Vigna & Berings, 2012; Zhou, 2015).

There is only a handful of studies exploring these links in gifted samples. For example, the Big Five traits of Agreeableness, Conscientiousness and Openness were found to predict academic achievement (scores on the American College Testing) in a sample of 161 gifted adolescents who had participated in Northwestern University's Midwest Academic Talent Search and/or the Northwestern University center for Talent Development (Mammadov et al., 2018). All three traits exerted significant direct associations of moderate (positive for Conscientiousness and Openness) to strong (negative for Agreeableness) effect on academic achievement. Furthermore, Conscientiousness predicted achievement indirectly through higher self-regulatory efficacy and autonomous motivation; and Openness predicted achievement indirectly through higher autonomous motivation (Mammadov et al., 2018).

Another pathway, through which personality traits may affect achievement, is via their role as resilience factors against behavioral difficulties (defined here as internalizing and externalizing problems) and psychopathology (Tosevski, Milovancevic & Gajic, 2010). For example, a study has shown that a personality profile characterized by high levels of Agreeableness, Conscientiousness, Extraversion and Openness, and low levels of Neuroticism was linked to reduced internalizing and externalizing behavioral problems among adolescents. Neuroticism was the strongest predictor of adolescents' internalizing and externalizing behavioral problems (Ling, Pheng, Sin & Soon-Aun, 2017). In turn, higher level of externalizing and internalizing behavioral problems predicted worse academic outcomes (lower grades and classroom adjustment levels) of adolescents in a longitudinal (three assessment waves over a period of two years) study (Ansary & Luthar, 2009). Other longitudinal research suggests that this effect is bidirectional: higher externalizing problems predict lower teacher-given grades (but not lower grades in standardized achievement tests); and lower grades predict increased future externalizing problems and lower self-esteem in adolescents (Zimmermann, Schütte, Taskinen & Köller, 2013).

The negative influence of behavioral difficulties on performance was detected as early as six years of age, with externalizing problems leading to school underachievement; which in turn predicts more future internalizing and externalizing problems (Van Lier et al., 2012). One study showed that gifted students achieved higher academic performance regardless of internalizing problems. Compared with nongifted peers, gifted adolescents showed higher levels of parent-report internalizing problems. This pattern of results suggests that

higher cognitive abilities may attenuate the effects of social, emotional, or behavioral difficulties on academic achievement (Eklund et al., 2015).

It has been argued that the Big Five, does not sufficiently capture variation across the whole spectrum of normal personality. In particular, its heterogeneous broad traits may be too few in number and additional traits are needed to adequately capture personality contribution to various outcomes, such as achievement and behavioral difficulties (Boyle, 2008). In the last decade there has been an increasing interest in the Dark Triad (DT) of personality – a cluster composed of three distinct, but partially overlapping personality traits: Machiavellianism, subclinical narcissism and subclinical psychopathy (Paulhus & Williams, 2002). Machiavellianism is synonymous with manipulation; individuals scoring high on Machiavellianism employ self-serving strategies; are master manipulators and deceivers, who care little for moral and societal norms (Kapoor, 2015). The construct of subclinical or “normal” narcissism includes facets retained from the clinical syndrome: grandiosity, entitlement, dominance, and superiority (Paulhus & Williams, 2002). Subclinical psychopathy is characterised by high impulsivity and thrill seeking along with low empathy (Paulhus & Williams, 2002).

The Dark Triad traits have received limited attention in relation to educational outcomes in selected or unselected samples. Narcissism is the only Dark Triad trait that has been explored in relation to achievement. Specifically, a recent longitudinal study has shown that narcissism may increase mental toughness contributing indirectly to higher school grades in adolescents (Papageorgiou et al., 2018). The strongest correlate of narcissism in this study was the mental toughness component of confidence. The link between narcissism and confidence may be key for braking the vicious cycle whereby externalizing problems lead to lower academic performance, which leads to lower self-esteem, which in turn leads to lower academic performance and higher internalizing problems (see model presented in Zimmermann et al., 2013).

Several further studies have shown that grandiose narcissism may be a resilience factor against psychopathology, including perceived stress and symptoms of depression (K. A. Papageorgiou et al., 2019, 2019; Papageorgiou, Wong & Clough, 2017). Furthermore, a study that utilized network analyses reported that narcissism may act as a bridge between the malevolent and prosocial side of human personality (K. A. Papageorgiou et al., 2019). The study suggested that broadening the domain of personality beyond the Big Five can improve the prediction of important outcomes and that networks may be a useful tool to move forward from a dichotomous way of perceiving personality traits, as beneficial or malevolent, to focusing on a dynamic continuum of personality (K. A. Papageorgiou et al., 2019).

Networks have been proposed as an alternative approach to models that focus exclusively on latent dimensions (Schmittmann et al., 2013). From the network perspective, the coalescence of several personality characteristics into a few major dimensions is viewed as a consequence of the interactions that take place within networks (Costantini et al., 2015). Concurrently modelling many elements of the personality system as a network, provides unique information on their connections with relevant outcomes.

This study is the first to explore and directly compare connections among personality traits (Big Five and Dark Triad), behavioral strengths (prosocial behavior) and difficulties (externalizing and internalizing problems) and school achievement in four groups of adolescents ($N = 1179$) who showed high achievement in either *Science*, *Arts*, *Sports* or *Literature*. Utilizing correlations, network analyses and stepwise linear regression models we investigated:

- 1 Correlations among personality (Big Five and Dark Triad); behavioral strengths and difficulties; and achievement (gifted adolescents' last year teacher awarded school grades and exam scores).

- 2 Differences between groups (Science, Arts, Sports or Literature) in personality, behavioral strengths and difficulties and achievement.
- 3 Networks of personality traits, behavioral strengths and difficulties and achievement and the degree to which their connections differ by sex and group.
- 4 The amount of variance explained by the Dark Triad traits in the gifted adolescents' behavioral strengths and difficulties and achievement, over and above the variance explained by the Big Five.

2. Methods

2.1. Sample

The sample included 1191 adolescents (576 males and 603 females; $M = 15.24$; $SD = 1.05$; $range = 14-18$ years). The participants were recruited at the educational centre Sirius (<https://sochisirius.ru/>), in Sochi, Russia, where high-achieving adolescents from different regions of the country come for educational and training purposes. The educational program usually lasts for 1 month. The participants were recruited from four tracks: Science ($N = 600$; 338 males), Arts ($N = 229$; 44 males), Sports ($N = 221$; 180 males) or Literature ($N = 141$; 14 males). Selection criteria for the centre attendance differs for different tracks. For the Science track, selection criteria include high performance in school subjects and winning in subject Olympiads (e.g. biology, chemistry, physics or mathematics) of different level (school, city, regional, state or international) (see Liashenko, Khalezov & Arsalidou, 2017 for discussion) and participation in school-level conferences and scientific competitions (e.g. with a project); good performance in university-level ability/knowledge tests. These criteria, tests and evaluations are developed and carried out by top universities and leading scientists, educational and industry representatives.

For the Art track (fine arts, sculpture, ballet, music performance), selection criteria are based on experts' evaluation of the students' performance or a piece of creative work. Students are required to present photo/video materials with paintings, sculptures, music instrument play, ballet dancing. Experts from specialised organisations then evaluate these materials. Among the experts are Honored Artists of the Russian Federation, professors at the Moscow State Academy of Choreography, literary critics, editors and publishers, dancers of the Bolshoi Theater, experts from the Russian Academy of Arts, etc. For the Sport track (chess, hockey, figure skating), selection criteria for the centre admission have been formulated by expert organisations (e.g. Russian Chess Federation, Ice Hockey Federation, Figure Skating Federation). Main criteria are high performance in regional, federal or international sport competitions. Among the experts are Olympic champions, world and European champions, Honored Masters of Sports, Trainers, and presidents of sport federations and clubs, etc.

The selection is objective and does not rely on school, city or region authorities' recommendations. For each programme, all information is combined to create a ranking for each applicant, which is used to select best students for admission. For example, out of 22,000 applicants, 400 were selected for the STEM track in July 2019 (<https://sochisirius.ru/news/2780>). The 'intellectually gifted' status of these students is further supported by a recent finding of average advantage of a STEM-selected sample at Sirius over university students from Russia and China in spatial ability tests (Cohen's d equals 1.34 and 0.54, respectively; Authors, in preparation), as well as the same unselected school sample reported in another study (Cohen's d equals 0.98; Authors, in preparation).

2.2. Procedure

Participants (the students) and their parents or guardians received information regarding the goals of the study and the voluntary basis

of their participation. Parents or legal guardians of participants provided written informed consent. Additionally, verbal consent was obtained from the adolescents before data collection. Adolescents completed computerized self-report questionnaires in groups under similar controlled conditions. The testing session lasted for one and a half hour. The participants did not receive compensation for taking part in the study.

2.3. Measures

The students filled in a socio-demographic inventory. The inventory asked them to provide information on their age, sex, educational track (i.e. Science, Arts, Sports or Literature) and their last year and state exam grades on thirteen school subjects: Russian language, Maths (Algebra), Geometry, Informatics, History, Geography, Biology, Social studies, Physics, Chemistry, English/Foreign language, Literature and Astronomy.

2.3.1. Questionnaire measures

The participants have completed the Russian versions of self-report questionnaire measures assessing the Big Five (the Big Five Inventory; BFI; John & Srivastava, 1999), the Dark Triad (the Short Dark Triad questionnaire; SD3; Jones & Paulhus, 2014) and behavioural strengths and difficulties (the Strengths and Difficulties Questionnaire; SDQ; Goodman, 2001). The Russian versions of the questionnaires have been validated previously for use in Russian samples. Specifically, the BFI has been translated and validated to Russian (Shchebetenko, 2014), with high reliability estimates (Cronbach's $\alpha = 0.68, 0.79, 0.78, 0.79, 0.80$ for Agreeableness, Conscientiousness, Extraversion, Neuroticism and Openness to experience, respectively) (Mishkevich, 2016). The SD3 has been translated and validated to Russian with high reliability estimates ($\alpha > 0.70$ for all scales; Egorova, Sitnikova & Parshikova, 2015). The SDQ has been translated and validated into Russian language (Ruchkin, Kaposov & Schwab-Stone, 2007) with satisfactory reliability for most scales (from $\alpha = 0.44$ for peer problems scale to $\alpha = 0.70$ for emotional problems scale; Ruchkin et al., 2007). In the current study we used four scales as it is recommended when conducting research with low-risk samples (Goodman, Lamping & Ploubidis, 2010): prosocial behavior; externalizing problems (a sum of the hyperactivity and conduct problems scales); internalizing problems (a sum of the emotional problems and peer problems scales); and total behavioral difficulties. The peer-problems scales that returned a low reliability estimate was not used independently in the main analyses of the current study. Similar reliability estimates were obtained in the current study for all questionnaire measures. (see Table S1 to S5 in supplementary material)."

2.3.2. School achievement

Students were asked to report their last year grades and grades on year 9 state exam in the subjects of Russian language and Maths (Algebra). These two subjects are compulsory for admission to most universities in Russia. Last year grade is a teachers' assessment of students' performance in Russian and Maths, on a scale of 2 = fail; 3 = satisfactory; 4 = good; and 5 = excellent. An average of last year grades in Russian language and Maths was used in a current study as the main measure of achievement (i.e. Achievement last year grade). For part of the analyses, we also used a composite of their state exam scores in year 9 (Achievement state exam) by averaging student-report exam scores in two subjects: Russian language and Maths. State exam is a standardized measure of students' performance as assessed during a formal examination taken at the end of year 9. State exam is a major education assessment tool with scores ranging from 0 to 70. These scores are converted into grades from 2 to 5 to match the scores of the teachers' assessment of the students (i.e. year grades). For exam-

ple, state exam scores of 0–14, 15–24, 25–33, 34–39 in Russian language corresponds to grades of 2, 3, 4 and 5, respectively. In the current study, students were asked to report their state exam scores from 2 to 5. The analyses involving the measure of Achievement state exams have utilized data from 578 out of 1191 participants since only this subsample had completed year 9 at the time of data collection.

2.4. Statistical analyses

2.4.1. Track differences

The possible effects of age and sex on personality, behavioral strengths and difficulties and achievement were tested – the alpha values were set to 0.05. The effects of sex and age were regressed out from all outcome measures, as suggested by Kohler and Kreuter (2012, p.278). These standardized residuals were used for all further analysis except for network analysis. Separate one-way Analysis of variance (ANOVA) models were used to test whether educational tracks significantly predicted personality, behavioral strengths and difficulties and achievement. As the number of participants differed across groups, Levene's test was used to test for equality of variances assumption. Welch ANOVA's were used for those outcomes for which this assumption was violated.

2.4.2. Network analyses

We employed network analysis to examine the connections among adolescents' personality traits, strengths and difficulties and achievement. Gaussian Graphical Model Networks (GGM; S. Epskamp, Borsboom & Fried, 2018) are particularly suitable to examine the complex pattern of relationships among traits and outcomes with an exploratory yet parsimonious approach. Furthermore, GGM networks aid the dissemination of results being able to summarize a complex pattern of connections among many variables with a simple graphical representation, which can be easily communicated to a broad audience.

Partial correlation networks are typically estimated using a *lasso* regularization via the graphical lasso algorithm, which reduces overfitting and results in more parsimonious and replicable network models (Epskamp & Fried, 2018). GGMs can therefore be seen as parsimonious models that encode predictive relationships among a set of variables. Unlike Structural Equation Modelling (SEM) and similar techniques, GGM allow for the examination of all possible pairwise relationships among a large number of variables through a model that is both parsimonious and exploratory (Costantini et al., 2019). Similar to SEM, GGM results in sparse models that include a limited number of parameters. In GGM networks, if two variables are not connected by an edge, this means that they are linearly independent conditioning on the others (Lauritzen, 1996). This makes GGM more informative than a simple correlational model (Costantini et al., 2015).

Once a network is computed, node predictability can be used to quantify the proportion of variance of each node that is explained within the network model. Nodes with zero predictability value cannot be predicted by the model, whereas nodes with a predictability value of 1 can be perfectly predicted (Haslbeck & Waldorp, 2018).

Recently, the replicability of psychological networks has been at the centre of a debate (Borsboom et al., 2017; Fried et al., 2018). For this reason, we estimated whether network estimates were sufficiently stable using bootstrap (S. Epskamp et al., 2018). In particular, we used the *correlation stability coefficient* (CS-coefficient), which allows assessing the stability of node-level indices such as predictability. Cutoff values of 0.25 and 0.50 have been suggested to indicate respectively sufficient stability and good stability (S. Epskamp et al., 2018).

We were also interested in examining whether the relationships among personality, behavioral strengths and difficulties and achievement differed by gender and by education tracks. First, we used the *Network Comparison Test* to test whether two independently esti-

mated GGMs are significantly different from each other (van Borkulo et al., 2017). In particular, invariance of *network structure* is operationalized by the largest difference between two corresponding edges in the two networks (index *M*), and the invariance of global strength (index *S*), the absolute sum of all edge weights in a network (van Borkulo et al., 2017). Since comparing four tracks with one another involved performing six tests, we applied a Bonferroni correction to keep Type-I error to the nominal value. If differences in networks across groups are expected, the Fused Graphical Lasso regularization can be employed instead of the graphical lasso algorithm to jointly estimate networks in different groups. This method applies a regularization on the differences among groups, thus resulting in more accurate edge estimates (Costantini et al., 2019; Danaher, Wang & Witten, 2014). Since the CS-coefficient is not available for networks estimated using Fused Graphical Lasso, we approximated it using the CS of the corresponding networks estimated using the graphical lasso (see also Fried et al., 2018).

Networks were estimated using the packages *bootnet* (S. Epskamp et al., 2018), *qgraph* (S. Epskamp et al., 2018; Epskamp, Cramer, Waldorp, Schmittmann & Borsboom, 2012) and *Estimate Group Network* (Costantini & Epskamp, 2017) in the R statistical software package (R Core Team, 2017). The network comparison test was performed using package *Network Comparison Test* (van Borkulo, 2016). Finally, network analysis was presented with the corresponding raw correlations to facilitate the inclusion of these findings in future meta-analyses.

2.4.3. Associations between personality, behavioral strengths and difficulties and achievement

Stepwise regressions were computed to explore personality as a predictor of behavioral strengths and difficulties and achievement in gifted adolescents. The Big Five traits were included as predictors of behavioral strengths and difficulties and achievement in the first step (Step 1); The Dark Triad traits were included as predictors of behavioral strengths and difficulties and achievement in the second step (Step 2); the Big Five and Dark Triad traits were included as predictors of behavioral strengths and difficulties and achievement in the third step (Step 3).

3. Results

3.1. Descriptive statistics, reliabilities and covariates

Descriptive statistics and reliability estimates for all measures are presented in Table S1 for the total sample. Tables S2, S3, S4 and S5 present descriptive statistics and reliability estimates separately for the Science, Arts, Sports and Literature tracks. Kurtosis and skewness were calculated to test for normality in the distributions (*threshold was set to 1.0 for both*). Cronbach's alphas were calculated to estimate the measures' internal consistency. All variables were approximately normally distributed, with the exception of the two composite variables of achievement: Achievement last year grade and Achievement state exam. These two variables were normalized using van der Waerden's formula and the normalized scores were used in further analysis.

Sex (see Table S6 for the total sample and Table S7 to S10 for the tracks of Science, Arts, Sports and Literature, respectively) and age (see Table S11) were explored as potential covariates. In the total sample, males scored higher than females on extraversion, psychopathy and Machiavellianism (*Cohen d* = 0.21 to 0.43, *p* < .001). Females scored higher than males on agreeableness, neuroticism, openness, prosocial behavior, internalizing problems, total behavioral difficulties and achievement last year grade (*Cohen d* = 0.21 to 0.80, *p* < .001). Age correlated positively with neuroticism, openness, internalizing problems, and achievement last year grade. Age correlated negatively

with extraversion and psychopathy. As such, age and sex were used as covariates in further analyses.

3.2. Correlations

Partial correlations (controlling for age and sex) between all study variables are presented in Table S12 (for the total sample) and in Tables S13 – S16 (for the tracks of Science, Arts, Sports and Literature, respectively).

3.3. Track differences

Significant track differences were found for most variables, with partial η^2 ranging from 0.02 to 0.56. Table S17 presents the results of the Analysis of Variance (ANOVA) post hoc tests. Means and Standard Deviations (SDs) for all variables are presented in Table 1. Fig. 1, presents track differences across all measures.

3.4. Networks of personality, behavioural strengths and difficulties and achievement

The network of Big Five, Dark Triad, behavioural strengths and difficulties and Achievement last year grade is reported in Fig. 2 with corresponding network edges reported in Table 2. Gaussian Graphical Model (GGM; Epskamp, Waldorp, Möttus & Borsboom, 2018) estimates require list-wise deletion of missing values (see method section for detail). As such, the network was estimated on 1177 individuals. In the main analysis, reported in Fig. 2, we operationalized achievement using only the last year grade, as the state exam had been taken by only 578 of the participants at the time of the study. Additional analyses were conducted to estimate a network involving both measures of achievement on a subset of 578 participants (see Fig. 4 and Tables S18 and S19 in the Supplementary Material).

The predictability of each node (Haslbeck & Fried, 2017; Haslbeck & Waldorp, 2018) is reported in the first column of Table 3. The cor-

Table 1
Differences in personality, behavioural strengths and difficulties and achievement among tracks (controlling for sex and age).

Variables	Science			Arts			Sports			Literature			Statistics		Partial η^2
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	F/Welch (df)		
Agree	568	-.11	.98	215	.07	1.00	214	.40	.92	132	-.04	1.03	14.95*** (3; 1125)		.038
Cons	568	-.18	.99	215	.12	.91	214	.53	.84	132	-.07	1.05	30.60*** (3; 1125)		.075
Extr +	568	-.13	1.03	215	.09	.95	214	.48	.70	132	-.13	1.09	32.81*** (3; 406.85)		.194
Neur +	568	.00	1.03	215	.15	.99	214	-.07	.73	132	-.06	1.16	2.55 (3; 402.75)		.018
Open	568	-.15	1.06	215	.33	.93	214	-.02	.86	132	.28	.84	17.42*** (3; 421.93)		.110
Mach +	572	.04	.99	215	-.00	.95	215	.35	.84	132	-.53	1.08	22.55*** (3; 400.10)		.144
Narc +	572	-.13	1.01	215	.10	.95	215	.47	.85	132	-.13	1.00	25.35*** (3; 405.56)		.157
Psyc	572	-.07	.97	215	.08	.92	215	.52	.92	132	-.43	1.00	31.67*** (3; 1130)		.077
Pros	566	-.14	1.01	215	.13	1.00	214	.41	.88	132	-.07	.92	17.14*** (3; 1123)		.043
Exte	566	-.02	.96	215	.07	.97	214	.28	1.05	132	-.28	.99	9.98*** (3; 1123)		.025
Inte +	566	.00	.96	215	.08	1.00	214	.06	.97	132	-.12	1.15	1.19 (3; 388.46)		.009
Total BD	566	-.01	.94	215	.09	.96	214	.19	1.10	132	-.23	1.03	5.78** (3; 1123)		.015
ALY +	578	.31	.80	215	-.036	1.11	215	-.081	.93	133	.40	.64	103.20*** (3; 404.46)		.433
ASE	327	.22	.81	96	-.61	1.08	18	-1.11	1.57	109	.03	.96	29.68*** (3; 68.94)		.563

Note: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$; Agr: Agreeableness; Cons: Conscientiousness; Extr: Extraversion; Neur: Neuroticism; Open: Openness to experience; Mach: Machiavellianism; Narc: Narcissism; Psyc: Psychopathy; Pros: Prosocial behavior; Exte: Externalizing problems; Inte: Internalizing problems; Total BD: Total behavioural difficulties; ALY: Achievement last year grade; ASE: Achievement state exam; Achievement last year grade and Achievement state exam variables have been normalized using van der Waerden's transformation to account for high skewness in the distribution. All means are in standardized residuals; Welch statistic was reported instead of F whenever Levene's test was significant (indicated by + in the first column).

Fig. 1. Differences in personality, behavioural strengths and difficulties and achievement among tracks. Note: The boxplot presents five summary statistics for the corresponding scale (the median, two hinges and two whiskers). The lower and upper hinges correspond to the first and third quartiles (the 25th and 75th percentiles). The upper and lower whiskers extend from the hinges to the most extreme data points. Agr: Agreeableness; Cons: Conscientiousness; Extr: Extraversion; Neur: Neuroticism; Open: Openness to experience; Mach: Machiavellianism; Narc: Narcissism; Psyc: Psychopathy; Pros: Prosocial behavior; Exte: Externalizing problems; Inte: Internalizing problems; Total BD: Total behavioural difficulties; ALY: Achievement last year grade; ASE: Achievement state exam; all scores are in standardized residuals.

Fig. 2. Network of personality, behavioural strengths and difficulties and Achievement last year grade in the overall sample; Agr: Agreeableness; Cons: Conscientiousness; Extr: Extraversion; Neur: Neuroticism; Open: Openness to experience; Mach: Machiavellianism; Narc: Narcissism; Psyc: Psychopathy; Pros: Prosocial behaviour; Exte: Externalizing problems; Inte: Internalizing problems; ALY: Achievement last year grade. Green lines indicate positive connections; red lines indicate negative connections; the thickness of the lines represent the strength of the connection.

Table 2
Network edges (above the main diagonal) and correlations (below the main diagonal) in the overall network.

	Extr	Agre	Cons	Neur	Open	Narc	Mach	Psyc	Pros	Inte	Exte	ALY
Extr		0.05	0.13	-0.19	0.13	0.34	-0.10	0.07	0.15	-0.38	0.29	0
Agre	0.20***		0	-0.12	0.02	0	-0.17	-0.33	0.45	-0.02	-0.09	0
Cons	0.29***	0.30***		-0.08	0.06	0.21	0.02	-0.05	0.10	0.08	-0.44	0
Neur	-0.43***	-0.25***	-0.34***		0.13	0	-0.08	0	0.11	0.40	0.16	0.12
Open	0.30***	0.18***	0.21***	0.03		0.21	-0.02	-0.03	0.17	0.03	0	0.10
Narc	0.54***	-0.03	0.30***	-0.22***	0.33***		0.24	0.19	0	-0.05	0.03	0
Mach	-0.04	-0.41***	-0.05	0.02	-0.04	0.28***		0.24	-0.06	0.07	-0.05	0
Psyc	0.10**	-0.55***	-0.24***	0.13***	-0.05	0.29***	0.45***		0	0	0.26	-0.10
Pros	0.26***	0.58***	0.27***	-0.05	0.31***	0.08**	-0.27***	-0.28***		0.07	0.02	-0.02
Inte	-0.55***	-0.26***	-0.29***	0.63***	-0.07*	-0.29***	0.11***	0.14***	-0.10***		0.26	0
Exte	0.02	-0.39***	-0.53***	0.38***	-0.02	0.04	0.15***	0.49***	-0.15***	0.38***		-0.12
ALY	-0.06	0.09**	0.09**	0.09**	0.13***	-0.03	-0.06*	-0.19***	0.05	0.02	-0.18***	0

Note. * $p < .05$, ** $p < .01$, *** $p < .001$; Extr: Extraversion; Agr: Agreeableness; Cons: Conscientiousness; Neur: Neuroticism; Open: Openness to Experience; Narc: Narcissism; Mach: Machiavellianism; Psyc: Psychopathy; Pros: Prosocial behavior; Inte: Internalizing problems; Exte: Externalizing problems; ALY: Achievement last year grade.

relation stability coefficient for predictability was 0.90 (S. Ep-skamp et al., 2018), indicating that even when 90% of the sample was randomly dropped, the predictability values had a 95% probability to show a correlation with the original values of at least 0.70, thus confirming the accuracy of the predictability index in the overall network.

Dark Triad traits were positively connected with each other in the network but showed different connections to the Big Five. Narcissism was positively connected to Extraversion and Conscientiousness, whereas Machiavellianism and psychopathy were negatively connected to Agreeableness. Externalizing and internalizing problems were

Table 3

Predictability of personality, behavioural strengths and difficulties, and achievement last year exam for all tracks, the sports track and for all tracks other than sports.

node	All 4 tracks	Sports track	Science, Art, & Literature Tracks
Agre	.55	.46	.49
Cons	.44	.43	.35
Extr	.58	.46	.49
Neur	.49	.44	.43
Open	.24	.15	.21
Mach	.32	.19	.26
Narc	.47	.28	.41
Psyc	.51	.41	.45
Pros	.42	.25	.38
Exte	.55	.61	.44
Inte	.56	.55	.49
ALY	.09	.06	.04

Agr: Agreeableness; Cons: Conscientiousness; Extr: Extraversion; Neur: Neuroticism; Open: Openness to experience; Mach: Machiavellianism; Narc: Narcissism; Psyc: Psychopathy; Pros: Prosocial behavior; Exte: Externalizing problems; Inte: Internalizing problems; ALY: Achievement last year grade. The results for the Sports track are presented separately because the Sports track network showed different structure to all other networks.

both connected to Neuroticism, but they showed differential connections with Extraversion and Conscientiousness: Externalizing problems were positively connected to Extraversion and negatively to Conscientiousness, whereas internalizing problems were positively connected to Conscientiousness and negatively to Extraversion. Externalizing problems were also positively connected to psychopathy. Achievement last year grade was positively connected to Openness and Neuroticism, and negatively to externalizing problems and psychopathy. The most predictable node was Extraversion. Internalizing and externalizing problems ranked third and fourth in predictability, with more than half of their variance being modelled within the network. In contrast, Achievement last year grade had the lowest predictability, 9%.

The Network Comparison Test (NCT; van Borkulo et al., 2017) employs a permutation procedure to test whether two networks are significantly different in terms of their structure, operationalized by the maximum absolute difference between two corresponding edges (M), and in terms of global strength, which is the sum of all absolute edge weights in a network (S). Using the NCT, we inspected whether the network structure was different in males and females and in differ-

ent tracks. The results showed that network connections were not significantly affected by sex, both in the structure ($M = 0.14$, $p = .18$) and in global strength ($S = 0.93$, $p = .23$). We performed six pairwise comparisons among the four track networks, using a Bonferroni correction. The NCT revealed that the sports track was significantly different from all other tracks. In particular, the sports track network had a different structure compared to the science ($M = 0.29$, $p = .016$), arts ($M = 0.38$, $p = .001$) and literature ($M = 0.44$, $p < .001$) tracks. Furthermore, the sports track differed significantly in network density compared to the science ($S = 2.83$, $p = .029$) and the arts tracks ($S = 2.42$, $p = .010$). No other significant differences among tracks emerged.

We further investigated this result by estimating two networks, one involving adolescents in the sports track and the other including all other participants, using a Fused Graphical Lasso regularization. The resulting networks are reported in Figs. 3A-B; predictability is reported in the last two columns of Table 3. The corresponding network edges are reported in Tables S18 and S19 in the supplementary material.

The CS-coefficients indicated that predictability estimates were highly stable both in the sports track network ($CS = 0.60$) and in the network of the other tracks ($CS = 0.90$). Additional analyses were conducted to estimate a network involving both measures of Achievement (last year grade and exam grade). The resulting network is reported in Fig. 4 and in Table S20. The predictability indices are reported in Table S21. The CS coefficient indicated that predictability was very stable also in this subsample ($CS = 0.85$). The Achievement state exam and the Achievement last year grade were strongly connected to each other. Among them, the Achievement last-year grade had a predictability of 0.19, which was slightly larger than that of the state exam grade 0.15.

3.5. Personality as a predictor of behavioral strengths and difficulties and achievement

The results of the stepwise regression models are presented in Table 4. At Step 1 the Big Five traits predicted 44%, 38%, 42%, 27% of the variance in prosocial behavior, externalizing problems, internalizing problems and total behavioral difficulties, respectively. In contrast, the Big Five predicted only 1% of the variance in Achievement last year grade in the total sample ($N = 1191$) and did not predict Achievement state exam ($N = 578$).

Fig. 3. Networks of personality, behavioral strengths and difficulties and Achievement last year grade estimated in the sports track (A) and in the Art, Literature and Science tracks (B); Agr: Agreeableness; Cons: Conscientiousness; Extr: Extraversion; Neur: Neuroticism; Open: Openness to experience; Mach: Machiavellianism; Narc: Narcissism; Psyc: Psychopathy; Pros: Prosocial behavior; Exte: Externalizing problems; Inte: Internalizing problems; ALY: Achievement last year grade.

Fig. 4. Network including two measures of school achievement. ALY: Achievement last year grade; ASE: Achievement state exam; Agr: Agreeableness; Cons: Conscientiousness; Extr: Extraversion; Neur: Neuroticism; Open: Openness to experience; Mach: Machiavellianism; Narc: Narcissism; Psyc: Psychopathy; Pros: Prosocial behavior; Exte: Externalizing problems; Inte: Internalizing problems.

At Step 2, Dark Triad traits predicted 8%, 29%, 18% and 51% of the variance in prosocial behavior, externalizing problems, internalizing problems and total behavioral difficulties, respectively. The Dark Triad predicted 6% of the variance in Achievement last year grade in the total sample ($N = 1191$) and did not predict Achievement state exam ($N = 578$).

At Step 3, Big Five and Dark Triad traits together predicted 44%, 49%, 48% and 51% of the variance in prosocial behavior, externalizing problems, internalizing problems and total behavioral difficulties, respectively. Big Five and Dark Triad traits together explained 8% of variance in Achievement last year grade in the total sample ($N = 1191$) and did not predict Achievement state exam ($N = 578$).

4. Discussion

The current study explored and directly compared personality traits that influence behavioral strengths and difficulties and achievement in four groups (tracks) of adolescents selected for high achievement in *Science, Arts, Sports or Literature*.

Correlation analyses indicated that personality traits shared a larger amount of variance with behavioral strengths and difficulties than with measures of achievement. One explanation for the overlap between personality measures and behavioral strengths and difficulties might be that measures used to assess them partly tap into similar constructs. In addition, at least in selected samples, personality may influence achievement through its shared variance with behavioral strengths and difficulties. For example, narcissism correlated negatively with behav-

ioral difficulties but did not significantly correlate with achievement. At the same time, achievement was correlated negatively with behavioral difficulties.

Further evidence for complex interrelationships among the traits is that, narcissism correlated positively with Extraversion and Openness and negatively with Neuroticism and internalizing problems. Machiavellianism and subclinical psychopathy showed a different pattern of positive correlations mainly with externalizing behavioral problems and negative correlations with Conscientiousness and Agreeableness. These findings suggest that narcissism may be protecting against internalizing problems (see also (Papageorgiou et al., 2019c); K. A. Papageorgiou et al., 2019). However, when personality was modelled as a network, narcissism was not connected to any type of behavioral problem. Instead, narcissism showed positive connections with prosocial traits such as prosocial behavior, Extraversion and Conscientiousness, as well as with the other two dark traits. These results and the position of narcissism in the network confirms previous findings in unselected adult samples (see K. A. Papageorgiou et al., 2019) suggesting that narcissism might act as a bridge between the prosocial and dark side of personality having the potential to influence outcomes for better or for worse. The fact that the network of personality in adolescents resembles (at least partially) networks of personality in adults is very important considering that adolescents' emotional state, that was shown to bias self-reports of personality (Querengässer & Schindler, 2014), shows higher variability in comparison to adults (Maciejewski, van Lier, Branje, Meeus, Koot, 2015). The observed similarities

Table 4

Stepwise regression analysis exploring personality as a predictor of strengths and difficulties and achievement of gifted adolescents.

	Pros	Exte	Inte	Total BD	ALY	ASE
Step 1						
Agre	.51***	−0.10***	−0.25***	−0.05*	−0.03	.01
Cons	.10***	−0.35***	.04	−0.17***	.04	.06
Extr	.17***	.43***	−0.25***	.08**	−0.13***	−0.06
Neur	.14***	.43***	.54***	.58***	−0.08*	.02
Open	.10***	.01	.04	.03	.01	.01
R ²	.44	.38	.42	.27	.01	.01
F	177.84 ***	137.75 ***	163.37 ***	152.86***	3.89 ***	1.41
Step 2						
Mach	−0.07*	.00	.24 ***	.15 ***	.03*	.02
Narc	.28 ***	−0.06*	−0.35 ***	−0.26 ***	−0.01*	−0.02
Psyc	−0.17 ***	.55 ***	.25 ***	.46 ***	−0.26	−0.11*
R ²	.08	.29	.18	.51	.06	.01
F	34.73 ***	155.72 ***	85.42 ***	139.27 ***	25.81 ***	2.07
Step 3						
Agre	.51 ***	.04	.10 ***	.04	−0.14 ***	−0.03
Cons	.12 ***	−0.35 ***	.04	−0.35 ***	.02	.03
Extr	.18 ***	.28 ***	−0.30 ***	.28 ***	−0.02	−0.04
Neur	.14 ***	.32 ***	.47 ***	.32 ***	−0.00	.04
Open	.11 ***	.00	.04	.00	.02	−0.06
Mach	−0.02	.05*	.14**	.05*	.01	.00
Narc	−0.03	.00	−0.08 **	.00	.02	.03
Psyc	.01	.36***	.19***	.36***	−0.30***	−0.12*
R ²	.44	.49	.48	.51	.08	.02
F	111.44 ***	138.60 ***	129.11 ***	149.83 ***	12.40 ***	1.17

Note. * $p < .05$, ** $p < .01$, *** $p < .001$; Agr: Agreeableness; Cons: Conscientiousness; Extr: Extraversion; Neur: Neuroticism; Open: Openness to experience; Mach: Machiavellianism; Narc: Narcissism; Psyc: Psychopathy; Pros: Prosocial behavior; Exte: Externalizing problems; Inte: Internalizing problems; Total BD: Total behavioral difficulties; ALY: Achievement last year grade; ASE: Achievement state exam; Achievement last year grade and Achievement state exam variables have been normalized using van der Waerden's transformation to account for high skewness in the distribution. The sample size when testing the association between personality and ASE is $N = 550$ as opposed to 1191 participants for all other analyses.

with adult samples may be partially explained by the specifics of the sample used in this study. This selected sample is comprised of individuals who are extremely hardworking and able, self-selected to apply for this intensive program, away from parents, possibly making them more independent and resilient on average. This explanation is speculative and it requires further research involving both selected and unselected samples. Furthermore research using experience sampling is needed to shed light on age differences in the interactions between personality dynamics and emotional state variability. Such research could have implications for detecting a clearer pattern of connections between personality and behavioral problems in selected and unselected samples of adolescents.

Analyses on track differences showed that the sports track was significantly different from other tracks for most variables. Specifically, individuals in the sports track scored higher than individuals on other tracks in prosocial traits (e.g. prosocial behavior, Extraversion and Agreeableness) but also in the Dark Triad and externalizing problems. In addition, adolescents in the sports track also scored lower in achievement. These findings require further exploration because they seem to suggest that adolescents, who are gifted in sports, exhibit more extreme behaviors and manifestations of normal personality traits across the spectrum of prosociality – dark traits. This finding is consistent with recent perspectives on personality research, which suggest that extreme standing on “desirable” trait continua translates into maladaptive behavior and undesirable outcomes (see Carter, Miller & Widiger, 2018).

Network analyses facilitated identifying the structure of personality, behavioral strengths and difficulties and achievement across the four tracks. Compared with other tracks, for the sports track, Extraversion had a stronger negative connection with Neuroticism and weaker positive connections with externalizing problems and narcissism. This sug-

gests that Extraversion might play a more beneficial role in the personality networks of young athletes than for other individuals in terms of reducing behavioural problems; but at the same time, it could affect negatively their achievement. Second, in the sports track, externalizing and internalizing problems had stronger connection with each other than in the other tracks, reflected in higher predictability within the sports track compared to other tracks. This might indicate that young athletes tend to experience either both types of behavioral difficulties or neither; whereas other gifted individuals are more likely to experience more specific types of difficulties. Furthermore, in the sports track externalizing problems were less connected to Conscientiousness and Neuroticism and more connected to Agreeableness than in the other tracks. This finding suggests that each personality trait may have a differential impact on externalizing problems in different samples. As such, increasing Agreeableness in elite athletes may have a stronger positive impact on reducing externalizing behavioral problems as compared to other types of gifted population. In the current sample, many of the athletes were hockey players that necessitate high levels of cooperation and teamwork. Finally, internalizing problems were directly negatively connected to Conscientiousness only in the sports track, suggesting that Conscientiousness might act as a protective factor for internalizing problems for athletes but not for other groups of gifted adolescents.

In terms of achievement, network analyses showed that teacher-rated school achievement, might be more influenced by personality than the objective performance measured by a standardized exam. Unlike Achievement state exam, greater Achievement last year grade was associated with higher Conscientiousness and Agreeableness; lower Machiavellianism and fewer externalizing problems – traits that may have particular interpersonal relevance. Achievement last year grades, but not Achievement state exam, also showed a positive connec-

tion with Neuroticism and a weak positive connection with internalizing problems. Consistent with results of several previous studies (e.g. Wang et al., 2014), this finding hints to the idea that a degree of anxiety (see high neuroticism) may be positive in terms of achieving higher grades and requires further exploration in order to identify optimum levels of these characteristics for increasing academic outcomes. Together these results suggest that teacher ratings might reflect some conscious or unconscious biases, such as judging more leniently students that they perceive as more focused on school tasks, who are well behaved in interpersonal contexts and who are more emotionally fragile. This is indirectly supported by another study (Gibb, Fergusson & Horwood, 2008) that showed reduced sex differences in achievement once teacher-reported behavioral problems were controlled for (males were rated more inattentive, restless and distractible than females). In contrast, performance in state exam was mostly disconnected from personality traits, the only connections being with lower prosocial behavior, psychopathy and Conscientiousness, although the last two connections were very weak.

Stepwise regression analyses showed that both the Big Five and the Dark Triad together explained almost half of the variation in behavioral strengths and difficulties. In contrast, the Big Five explained only a very small portion of the variance in achievement in gifted adolescents: even Conscientiousness, the most robustly linked to achievement (of the Big Five; O'Connor et al., 2007; Furnham et al., 2009) was not associated significantly with either Achievement last year grades or Achievement state exams in our study. The Dark Triad explained a small but considerably larger (as compared to the Big Five) amount of variation in Achievement last year grades (6%). Similarly, to network analyses, the regression models, indicated that Achievement state exam was mainly unaffected by personality. The interpretation of these results is limited by the fact that Achievement state exam grade was available for only approximately half of the sample (i.e. those individuals that had completed year 9 state exams at the time of testing, $N = 578$). The lack of significant associations between personality and Achievement state exam may have resulted from reduced power to find weak effects. Another potential limitation is that the grading scale used in the schools is too crude to capture most of the variation in achievement. Further research is needed to test whether teachers' perception of the students' personality influence their evaluation of the students' performance, and whether this may differ depending on specific grading systems used in different educational systems.

In conclusion, the present study was first to utilize network analyses in gifted adolescents; the findings provide new insights into the role of personality and behavioral strengths and difficulties in gifted adolescents' performance. The results provided evidence of differences and similarities across the four tracks in the structure of personality and its interconnections with behavioral strengths and difficulties and achievement. The study with high achieving adolescents supported some recent findings with unselected samples, such as the possible role of narcissism as the bridge between the prosocial and dark side of personality (see K. A. Papageorgiou et al., 2019). Narcissism was the only trait (of the Dark Triad) to correlate negatively with internalizing problems, potentially protecting against negative effects of these problems on achievement (Ansary & Luthar, 2009). This indicates that, under some circumstances narcissism may neutralize the influence of dark personality traits on prosocial behavior and behavioral difficulties – boosting performance in selected and unselected samples. The results of the study also suggest that personality traits may play a role as resilience factors against behavioral difficulties – boosting performance indirectly. We plan to use mediation models for gaining further understanding of the pathways through which personality affects achievement through behavioral strengths and difficulties. We also plan to directly compare selected and unselected samples further subdivid-

ing tracks into more homogeneous groups e.g. hockey vs. chess players – once adequate samples reached in the ongoing study.

Uncited references

, K. A. Papageorgiou et al. (2019), , and .

Declaration of Competing Interest

All authors declare no conflicts of interest.

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Supplementary materials

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References

- Ansary, N. S., & Luthar, S. S. (2009). Distress and academic achievement among adolescents of affluence: A study of externalizing and internalizing problem behaviors and school performance. *Development and Psychopathology*, 21, 319. doi:10.1017/s0954579409000182.
- Borsboom, D., Fried, E. I., Epskamp, S., Waldorp, L. J., van Borkulo, C. D., & van der Maas, H. L., & Cramer, A. O. (2017). False alarm? A comprehensive reanalysis of "evidence that psychopathology symptom networks have limited replicability" by Forbes, Wright, Markon, and Krueger (2017). *Journal of Abnormal Psychology*, 126, 989–999. doi:10.1037/abn0000306.
- Boyle, J. (2008). *The public domain: Enclosing the commons of the mind*. London: Yale University Press. New Haven, Conn..
- Carragher, N., Teesson, M., Sunderland, M., Newton, N. C., Krueger, R. F., & Conrod, P. J. (2015). The structure of adolescent psychopathology: A symptom-level analysis. *Psychological Medicine*, 46, 981–994. doi:10.1017/s0033291715002470.
- Carter, N. T., Miller, J. D., & Widiger, T. A. (2018). Extreme personalities at work and in life. *Current Directions in Psychological Science*, 27, 429–436. doi:10.1177/0963721418793134.
- Costantini, G., & Epskamp, S. (2017). EstimateGroupNetwork: Perform the joint graphical lasso and selects tuning parameters. URL <https://CRAN.R-project.org/package=EstimateGroupNetwork>. R package version 0.1.2.
- Costantini, G., Epskamp, S., Borsboom, D., Perugini, M., Möttus, R., & Waldorp, L. J., & Cramer, A. O. (2015). State of the aRT personality research: A tutorial on network analysis of personality data in R. *Journal of Research in Personality*, 54, 13–29. doi:10.1016/j.jrp.2014.07.003.
- Costantini, G., Richetin, J., Preti, E., Casini, E., Epskamp, S., & Perugini, M. (2019). Stability and variability of personality networks. A tutorial on recent developments in network psychometrics. *Personality and Individual Differences*, 136, 68–78. doi:10.1016/j.paid.2017.06.011.
- Danaher, P., Wang, P., & Witten, D. M. (2014). The joint graphical lasso for inverse covariance estimation across multiple classes. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, 76, 373–397. doi:10.1111/rssb.12033.
- De Feyter, T., Caers, R., Vigna, C., & Berings, D. (2012). Unravelling the impact of the big five personality traits on academic performance: The moderating and mediating effects of self-efficacy and academic motivation. *Learning and Individual Differences*, 22, 439–448. doi:10.1016/j.lindif.2012.03.013.
- Dumfart, B., & Neubauer, A. C. (2016). Conscientiousness is the most powerful noncognitive predictor of school achievement in adolescents. *Journal of Individual Differences*, 37, 8–15. doi:10.1027/1614-0001/a000182.
- Egorova, M. S., Sitnikova, M. A., & Parshikova, O. V. (2015). Adaptation of the Short Triad Questionnaire. *Psychological Research: Electronic Scientific Journal*, 8, 1.
- Eklund, K., Tanner, N., Stoll, K., & Anway, L. (2015). Identifying emotional and behavioral risk among gifted and nongifted children: A multi-gate, multi-informant approach. *Social Psychology Quarterly*, 30, 197–211. doi:10.1037/spq0000080.
- Epskamp, S., Borsboom, D., & Fried, E. I. (2018). Estimating psychological networks and their accuracy: A tutorial paper. *Behavior Research Methods*, 50, 195–212. doi:10.3758/s13428-017-0862-1.
- Epskamp, S., Costantini, G., Haslbeck, J., Cramer, A.O.J., Waldorp, L.J., Schmittmann, V.D. et al. (2018). qgraph: Graph plotting methods, psychometric data visualization and graphical model estimation. [computer software manual]. Retrieved from <http://Cran.r-project.org/package=qgraph> (R package version 1.3.1).

- Epskamp, S., Cramer, A., Waldorp, L., Schmittmann, V., & Borsboom, D. (2012). qgraph: Network visualizations of relationships in psychometric data. *Journal of Statistical Software*, 48, 1–18. doi:10.18637/jss.v048.i04.
- Epskamp, S., & Fried, E. I. (2018). A tutorial on regularized partial correlation networks. *Psychological Methods*, 23, 617–634. doi:10.1037/met0000167.
- Epskamp, S., Waldorp, L. J., Möttus, R., & Borsboom, D. (2018). The Gaussian graphical model in cross-sectional and time-series data. *Multivariate Behavioral Research*, 53, 453–480. doi:10.1080/00273171.2018.145482.
- Fried, E. I., Eidhof, M. B., Palic, S., Costantini, G., Huisman-van Dijk, H. M., & Bockting, C. L. (2018). Replicability and generalizability of posttraumatic stress disorder (PTSD) networks: A cross-cultural multisite study of PTSD symptoms in four trauma patient samples. *Clinical Psychological Science*, 6, 335–351. doi:10.1177/2167702617745092.
- Furnham, A., Monsen, J., & Ahmetoglu, G. (2009). Typical intellectual engagement, big five personality traits, approaches to learning and cognitive ability predictors of academic performance. *British Journal of Educational Psychology*, 79, 769–782. doi:10.1348/978185409x412147.
- Gibb, S. J., Fergusson, D. M., & Horwood, L. J. (2008). Gender differences in educational achievement to age 25. *Australian Journal of Education*, 52(1), 63–80. doi:10.1177/000494410805200105.
- Goodman, A., Lamping, D. L., & Ploubidis, G. B. (2010). When to use broader internalising and externalising subscales instead of the hypothesised five subscales on the strengths and difficulties questionnaire (SDQ): Data from British parents, teachers and children. *Journal of Abnormal Child Psychology*, 38, 1179–1191. doi:10.1007/s10802-010-9434-x.
- Goodman, R. (2001). Psychometric properties of the strengths and difficulties questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40, 1337–1345. doi:10.1097/00004583-200111000-00015.
- Haslbeck, J. M., & Waldorp, L. J. (2018). How well do network models predict observations? On the importance of predictability in network models. *Behavior Research Methods*, 50, 853–861. doi:10.3758/s13428-017-0910-x.
- John, O. P., & Srivastava, S. (1999). The big five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of Personality: Theory and Research*, 2, 102–138. doi:10.4236/ojpp.2016.62019.
- Jones, D. N., & Paulhus, D. L. (2014). Introducing the short dark triad (SD3) a brief measure of dark personality traits. *Assessment*, 21, 28–41. doi:10.1177/1073191113514105.
- Kapoor, H. (2015). The creative side of the dark triad. *Creativity Research Journal*, 27, 58–67. doi:10.1080/10400419.2014.961775.
- Kohler, U., & Kreuter, F. (2012). Data analysis using stata. Stata Press. 3rd ed. College Station, TX.
- Lauritzen, S. L. (1996). Graphical models: 17. Clarendon Press.
- Lee, S.-Y., An, D., & Choe, S.-U. (2019). Predicting psychiatric symptoms by personality types for gifted students. *High Ability Studies*, 1–22. doi:10.1080/13598139.2019.1589428.
- Ling, T. Z., Pheng, J. K. A., Sin, W. W., & Soon-Aun, T. (2017). The relationship between personality traits and behavioral problems among adolescents in Malaysia. *Sains Humanika*, 9, 29–35. doi:10.11113/sh.v9n3-2.1270.
- Mammadov, S., Cross, T. L., & Ward, T. J. (2018). The big five personality predictors of academic achievement in gifted students: Mediation by self-regulatory efficacy and academic motivation. *High Ability Studies*, 1–23. doi:10.1080/13598139.2018.1489222.
- Mishkevich, A. M. (2016). On the use of the Russian version of the “Big five inventory” in the study of adolescents. *Bulletin of Perm University. Philosophy. Psychology. Sociology*, 1.
- Noftle, E. E., & Robins, R. W. (2007). Personality predictors of academic outcomes: Big five correlates of GPA and SAT scores. *Journal of Personality and Social Psychology*, 93, 116–130. doi:10.1037/0022-3514.93.1.116.
- O'Connor, M. C., & Paunonen, S. V. (2007). Big five personality predictors of post-secondary academic performance. *Personality and Individual Differences*, 43, 971–990. doi:10.1016/j.paid.2007.03.017.
- Papageorgiou, K. A., Benini, E., Bilello, D., Gianniou, F.-M., Clough, P. J., & Costantini, G. (2019). Bridging the gap: A network approach to dark triad, mental toughness, the big five and perceived stress. *Journal of Personality*, doi:10.1111/jopy.12472.
- Papageorgiou, K. A., Denovan, A., & Dagnall, N. (2019). The positive effect of narcissism on depressive symptoms through mental toughness: Narcissism may be a dark trait but it does help with seeing the world less grey. *European Psychiatry: The Journal of the Association of European Psychiatrists*, 55, 74–79. doi:10.1016/j.eurpsy.2018.10.002.
- Papageorgiou, K. A., Gianniou, F.-M., Wilson, P., Moneta, G. B., Bilello, D., & Clough, P. J. (2019). The bright side of dark: Exploring the positive effect of narcissism on perceived stress through mental toughness. *Personality and Individual Differences*, 139, 116–124. doi:10.1016/j.paid.2018.11.004.
- Papageorgiou, K. A., Malanchini, M., Denovan, A., Clough, P. J., Shakeshaft, N., & Schofield, K. (2018). Longitudinal associations between narcissism, mental toughness and school achievement. *Personality and Individual Differences*, 131, 105–110. doi:10.1016/j.paid.2018.04.024.
- Papageorgiou, K. A., Wong, B., & Clough, P. J. (2017). Beyond good and evil: Exploring the mediating role of mental toughness on the dark triad of personality traits. *Personality and Individual Differences*, 119, 19–23. doi:10.1016/j.paid.2017.06.031.
- Paulhus, D. L., & Williams, K. M. (2002). The dark triad of personality: Narcissism, Machiavellianism, and psychopathy. *Journal of Research in Personality*, 36, 556–563. doi:10.1016/s0092-6566(02)00505-6.
- Poropat, A. E. (2009). A meta-analysis of the five-factor model of personality and academic performance. *Psychological Bulletin*, 135, 322–338. doi:10.1037/a0014996.
- Rindermann, H., & Neubauer, A. C. (2001). The influence of personality on three aspects of cognitive performance: Processing speed, intelligence and school performance. *Personality and Individual Differences*, 30, 829–842. doi:10.1016/s0191-8869(00)00076-3.
- Rinn, A. N., & Majority, K. L. (2018). The social and emotional world of the gifted.. *Handbook of giftedness in children* (pp. 49–63). Springer, Cham.
- Ruchkin, V., Kopusov, R., & Schwab-Stone, M. (2007). The strength and difficulties questionnaire: Scale validation with Russian adolescents. *Journal of Clinical Psychology*, 63, 861–869. doi:10.1002/jclp.20401.
- Schmittmann, V. D., Cramer, A. O. J., Waldorp, L. J., Epskamp, S., Kievit, R. A., & Borsboom, D. (2013). Deconstructing the construct: A network perspective on psychological phenomena. *New Ideas in Psychology*, 31, 43–53. doi:10.1016/j.newideapsych.2011.02.007.
- Shchebetenko, S. A. (2014). “The best man in the world”: Attitudes toward personality traits. *psycholo. Journal of Higher School of Economics*, 11, 129–148.
- Tosevski, D. L., Milovancevic, M. P., & Gajic, S. D. (2010). Personality and psychopathology of university students. *Current Opinion in Psychiatry*, 23, 48–52. doi:10.1097/ycp.0b013e328333d625.
- van Borkulo, C. D., Boschloo, L., Kossakowski, J., Tio, P., Schoevers, R. A., & Borsboom, D., & Waldorp, L. J. (2017). Comparing network structures on three aspects: A permutation test. *Manuscript Submitted for Publication*. doi:10.13140/RG.2.2.29455.38569.
- van Borkulo, C.D. (2016). NetworkComparisonTest: Statistical comparison of two networks based on three invariance measures, 2016. <https://CRAN.R-project.org/package=NetworkComparisonTest>. R package version 2.0.1
- Van Lier, P. A. C., Vitaro, F., Barker, E. D., Brendgen, M., Tremblay, R. E., & Boivin, M. (2012). Peer victimization, poor academic achievement, and the link between childhood externalizing and internalizing problems. *Child Development*, 83, 1775–1788. doi:10.1111/j.1467-8624.2012.01802.x.
- Vötter, B., & Schnell, T. (2019). Bringing giftedness to bear: Generativity, meaningfulness, and self-control as resources for a happy life among gifted adults. *Frontiers in Psychology*, 10, 1972. doi:10.3389/fpsyg.2019.01972.
- Wirthwein, L., Bergold, S., Preckel, F., & Steinmayr, R. (2019). Personality and school functioning of intellectually gifted and nongifted adolescents: Self-perceptions and parents' assessments. *Learning and Individual Differences*, 73, 16–29. doi:10.1016/j.lindif.2019.04.003.
- Zhou, M. (2015). Moderating effect of self-determination in the relationship between big five personality and academic performance. *Personality and Individual Differences*, 86, 385–389. doi:10.1016/j.paid.2015.07.005.
- Zimmermann, F., Schütte, K., Taskinen, P., & Köller, O. (2013). Reciprocal effects between adolescent externalizing problems and measures of achievement. *Journal of Educational Psychology*, 105, 747–761. doi:10.1037/a0032793.