Big Five Personality Traits and Academic Specialization in Late Adolescence: A Study of Brooklyn Technical High School Students

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Abstract

Personality has been associated with academic achievement, vocational interests, and university major selection, yet considerably less is known about whether personality differences across academic fields are already evident during adolescence. The present study examined Big Five personality traits across academic specializations among 94 students at Brooklyn Technical High School. Participants completed a 25-item self-report questionnaire measuring Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience and reported their academic major and grade point average (GPA). Individual majors were consolidated into four academic groups: Engineering, Humanities, Math & Finance, and Sciences. Five one-way analyses of variance (ANOVAs) examined personality differences across academic groups, while Pearson correlations examined associations between personality and GPA. Neuroticism differed significantly across academic groups, whereas Extraversion, Agreeableness, Conscientiousness, and Openness did not. GPA was positively correlated with Conscientiousness ($r = .243$, $p = .021$) and Extraversion ($r = .233$, $p = .027$) and negatively correlated with Neuroticism ($r = -.256$, $p = .015$). Agreeableness and Openness demonstrated little relationship with GPA. These findings suggest that selected personality traits are associated with academic performance during adolescence, while the broader personality differences across academic disciplines reported among university students may be less differentiated at this earlier stage of educational specialization.

Introduction

Personality describes relatively enduring patterns of thought, emotion, and behavior through which individuals differ from one another. One of the most established frameworks for organizing these differences is the Five-Factor Model, commonly referred to as the Big Five. The model organizes personality into five broad dimensions: Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Goldberg, 1992; John et al., 2008). Openness to Experience reflects intellectual curiosity, imagination, creativity, and receptiveness to new ideas and experiences. Conscientiousness describes tendencies toward organization, self-discipline, persistence, and goal-directed behavior. Extraversion reflects sociability, assertiveness, energy, and a tendency to seek interaction with others. Agreeableness involves characteristics such as cooperation, trust, empathy, and concern for others. Neuroticism reflects a greater tendency to experience negative emotions such as worry, anxiety, and emotional instability. The Big Five has been widely applied to questions extending beyond personality itself, including how individual differences relate to educational performance, interests, and choices.

One particularly well-established relationship exists between personality and academic achievement. Poropat (2009), in a meta-analysis drawing on cumulative samples exceeding 70,000 participants, found significant associations between academic performance and

Agreeableness, Conscientiousness, and Openness. Conscientiousness was especially important and added predictive value beyond intelligence. Vedel's (2014) systematic review and meta-analysis of tertiary students similarly identified Conscientiousness as the strongest Big Five correlate of GPA, with a weighted correlation of r = .26. Pearson's correlation coefficient (*r*) measures the direction and strength of a linear relationship between two variables, ranging from −1 to +1, with values closer to either extreme indicating stronger relationships. An *r* of .26 therefore represents a positive but modest association between Conscientiousness and GPA. Together, these findings suggest that academic performance reflects not only cognitive ability but also behavioral characteristics such as organization, persistence, self-discipline, and goal-directed behavior.

The relationship between personality and education may extend beyond academic performance to the types of academic and vocational environments individuals prefer. Larson, Rottinghaus, and Borgen (2002) meta-analyzed relationships between Big Five personality characteristics and Holland's vocational interest domains. Several relationships were substantial, including Artistic-Openness (r = .48), Enterprising-Extraversion (r = .41), Social-Extraversion (r = .31), Investigative-Openness (r = .28), and Social-Agreeableness (r = .19). These patterns provide a plausible bridge between personality traits and educational choice: students with different personality characteristics may develop different interests and become attracted to different academic environments.

This possibility has been examined directly through comparisons of students enrolled in different university majors. Vedel's (2016) systematic review identified 12 eligible studies comprising 13,389 students, and 11 of the 12 studies reported significant differences in one or more Big Five traits across academic majors. Arts and humanities students consistently scored relatively high in Openness and Neuroticism; political science students also scored high in Openness; economics, law, political science, and medicine students tended to score high in Extraversion; and medicine, psychology, arts/humanities, and science students tended to score high in Agreeableness. The magnitude of these differences varied by trait and field. Vedel found that medium-sized differences appeared repeatedly for several Big Five traits, while the largest and most consistent differences were generally found for Openness, particularly in comparisons involving arts and humanities students.

Openness is particularly relevant when considering differences between humanities-oriented and more technical academic fields. Vedel (2016) found arts and humanities students consistently high in Openness. Openness encompasses characteristics involving intellectual curiosity, preference for novelty, imagination, and receptiveness to new ideas and experiences. Academic environments emphasizing interpretation, human experience, creativity, and multiple perspectives may therefore be especially compatible with individuals higher in Openness. Based on this literature, the present study predicted that students classified within Humanities would demonstrate greater Openness than students in more technical academic groups.

Previous major-choice research also provides reason to expect differences in the socially oriented dimensions of Extraversion and Agreeableness. Vedel (2016) reported relatively high Extraversion in fields including economics, law, political science, and medicine, while relatively high Agreeableness appeared in medicine, psychology, arts/humanities, and sciences. Larson et al. (2002) likewise found Extraversion associated with Enterprising and Social vocational interests and Agreeableness associated with Social interests. Although these patterns are less

uniform than the findings for Openness, they suggest that disciplines differing in interpersonal orientation may attract students with different social personality characteristics.

Conscientiousness was also expected to be educationally relevant. Conscientiousness encompasses organization, persistence, reliability, and goal-directed behavior and has repeatedly demonstrated relationships with academic performance (Poropat, 2009; Vedel, 2014). Because several Engineering, Science, and quantitative pathways in the present study involve structured and technically demanding coursework, the study explored whether Conscientiousness differed across academic groups. Independent of major choice, Conscientiousness was specifically hypothesized to correlate positively with GPA. This prediction was based on previous meta-analytic evidence: Vedel (2014) found Conscientiousness to be the strongest Big Five correlation of GPA, with a weighted correlation of $r = .26$. This relationship may reflect the academic advantages associated with characteristics central to Conscientiousness, including organization, persistence, self-discipline, and goal-directed behavior

A useful theoretical explanation for personality differences across academic environments is person-environment fit. Students do not necessarily choose academic fields independently of their existing interests and characteristics. Instead, individuals may seek environments that provide greater compatibility with their preferences, abilities, interests, and personality. Personality differences across university majors may therefore result partly from self-selection, as individuals enter fields that correspond with their existing characteristics (Vedel, 2016).

Selection, however, may represent only part of the relationship. Students spend substantial time interacting with their educational environments, which expose them to different coursework, expectations, peers, activities, and career possibilities. Personality and educational specialization could therefore develop alongside one another rather than existing in a simple one-directional relationship.

This issue is especially relevant during adolescence. Klimstra et al. (2012) examined Big Five personality traits and educational identity longitudinally across four annual measurements in late adolescents and found meaningful longitudinal associations between personality and educational identity formation. Educational choices during this period therefore occur while students' personalities and academic identities are still developing.

Despite substantial research examining personality across university majors, the developmental timing of these differences remains less clear. University samples capture individuals after they have selected an academic discipline and begun substantial exposure to that environment. Studying students who have made a meaningful academic choice before university provides an opportunity to examine whether comparable personality differences are already evident earlier in the educational trajectory.

Brooklyn Technical High School provides an unusual setting in which to investigate this question. Students select specialized academic majors at the end of sophomore year and subsequently complete discipline-specific coursework. The school's majors include engineering, natural science, quantitative, social science, and interdisciplinary pathways, many of which involve substantial laboratory, technical, project-based, or experiential work. Students therefore do not merely report an intended future field; they participate in distinct academic environments while still in high school.

The present study examined whether Big Five personality characteristics differed among Brooklyn Tech students across four broad academic specializations: Engineering, Humanities, Math & Finance, and Sciences. Previous research has established relationships between Big Five personality traits, academic performance, vocational interests, and university major selection. However, most research comparing personality across academic fields has focused on university students, leaving less understood about when these differences first emerge. In particular, it remains unclear whether personality differences associated with academic specialization are already evident during late adolescence, after students have begun pursuing distinct academic pathways but before entering college. By studying Brooklyn Tech students who have already selected and participated in specialized majors, the present study provides an opportunity to examine this gap at an earlier stage of educational development. Based on previous research, Humanities students were expected to demonstrate higher Openness than students in more technical fields; Extraversion and Agreeableness were expected to vary across socially/human-oriented and technical pathways; and Conscientiousness was examined across the academic groups. In addition, Conscientiousness was predicted to correlate positively with GPA. More broadly, the study sought to determine whether personality differences documented among university majors are already evident during late adolescence.

Method

Participants and Study Setting

Participants were 94 students attending Brooklyn Technical High School in New York City. Students at Brooklyn Tech select specialized academic majors at the end of sophomore year and subsequently complete discipline-specific coursework associated with those majors. The major system made the school particularly relevant to the present research because participants had already made a meaningful academic choice and were experiencing specialized academic environments prior to university enrollment.

Participants were recruited through social media. Participation was anonymous, and no personally identifying information was collected. Participants reported their GPA and Brooklyn Technical High School academic major and completed the 25-item Big Five personality questionnaire. No additional demographic information was collected.

Personality Measure

Personality was assessed using a 25-item self-report questionnaire developed for the present study around the five dimensions of the Big Five model: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience. Five statements assessed each personality dimension, providing equal representation of the five traits while maintaining a relatively brief questionnaire. Participants responded using a five-point Likert-type scale ranging from Strongly Disagree (1) to Strongly Agree (5). Both positively and negatively keyed statements were included. Negatively keyed items were reverse-scored so that higher numerical scores consistently represented greater levels of the corresponding trait. Scores for the five items associated with each trait were summed, producing possible scores from 5 to 25.

The questionnaire was developed specifically for the present study rather than administered as a previously validated standardized Big Five inventory. Its five-trait structure, self-descriptive item format, Likert-type response system, and use of positively and negatively keyed items are

consistent with established approaches to Big Five measurement (John et al., 2008). The lack of independent validation of this specific 25-item instrument is considered as a limitation.

Personality Questionnaire Items by Trait

Trait	Item	Statement
Extraversion	1	I am talkative.
	2	I am outgoing, sociable.
	3	I am reserved.*
	4	I am full of energy.
	5	I tend to be quiet.*
Agreeableness	6	I am helpful and unselfish with others.
	7	I am generally trusting.
	8	I tend to find fault with others.*
	9	I am considerate and kind.
	10	I can be cold and distant.*

Conscientiousness	11	I am organized.
	12	I am reliable and can be counted on.
	13	I tend to be lazy.*
	14	I do things efficiently.
	15	I make plans and follow through.
Neuroticism	16	I worry a lot.
	17	I get nervous easily.
	18	I am relaxed, handle stress well.*
	19	I can be moody.
	20	I remain calm under pressure.*
Openness to Experience	21	I am curious about many different things.
	22	I have a vivid imagination.

23	I prefer routine over new experiences.*
24	I enjoy thinking about abstract ideas.
25	I am interested in art, music, or literature.

Note. Items marked with an asterisk (*) were reverse-scored using the formula 6 − original response. Scores for each personality dimension were calculated by summing the five corresponding items, yielding possible scores ranging from 5 to 25. The original questionnaire also included two exploratory questions concerning major satisfaction and favorite season, which were excluded from the present analyses.

Academic Specialization

Participants reported their Brooklyn Tech academic major. Because the dataset contained numerous individual majors, some represented by relatively few participants, the majors were consolidated into four broader academic groups: Engineering, Humanities, Math & Finance, and Sciences. Classification was based primarily on curricular orientation while also allowing sufficiently sized groups for statistical analysis. The resulting sample included Engineering (n = 22), Humanities (n = 23), Math & Finance (n = 19), and Sciences (n = 30).

Academic Performance

Participants self-reported GPA on a 1-100 scale. GPA was treated as a continuous measure of academic performance.

Statistical Analysis

Five one-way analyses of variance (ANOVAs) were conducted to determine whether mean scores for Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness differed across the four academic groups. Statistical significance was evaluated at alpha = .05. Pearson product-moment correlations were calculated between GPA and each personality trait. Analyses were conducted using Microsoft Excel.

Results

Personality Differences Across Academic Groups

Table 1

One-Way ANOVA Results for Big Five Personality Traits Across Academic Groups

Personality trait	F(3, 90)	p-value	Significant?
Extraversion	0.72	.544	No
Agreeableness	0.65	.586	No
Conscientiousness	0.46	.713	No
Openness	1.24	.298	No
Neuroticism	**3.88**	**.012**	**Yes**

Note. Statistical significance was evaluated at α = .05.

Five separate one-way ANOVAs examined personality differences across the four academic groups. As shown in Table 1, Neuroticism was the only trait to demonstrate a statistically significant overall difference, $F(3, 90) = 3.88$, $p = .012$. Science students had the highest mean Neuroticism score ($M = 16.73$), followed by Humanities ($M = 16.09$), Math & Finance ($M = 14.26$), and Engineering ($M = 13.95$). Although Humanities students had the highest mean Openness score ($M = 20.22$), the overall difference was not statistically significant, $F(3, 90) = 1.24$, $p = .298$. Figures 1–5 display the group means with standard-error bars.

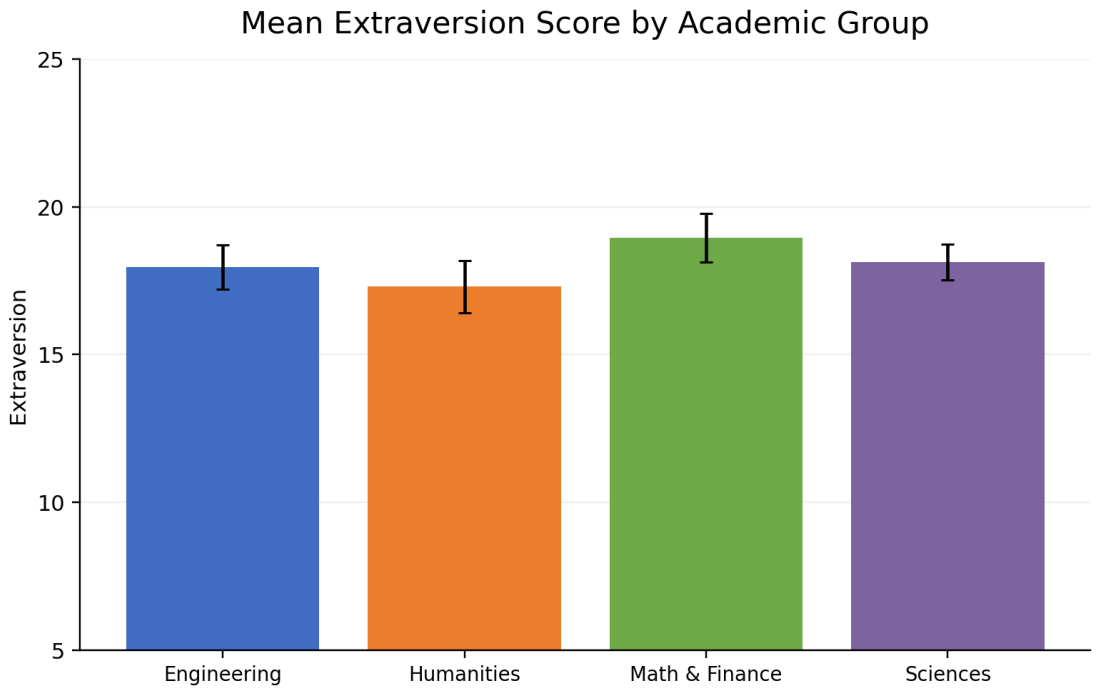


Figure 1. Mean Extraversion Score by Academic Group. Overall group differences were not statistically significant, F(3, 90) = 0.72, p = 0.544. Error bars represent standard errors.

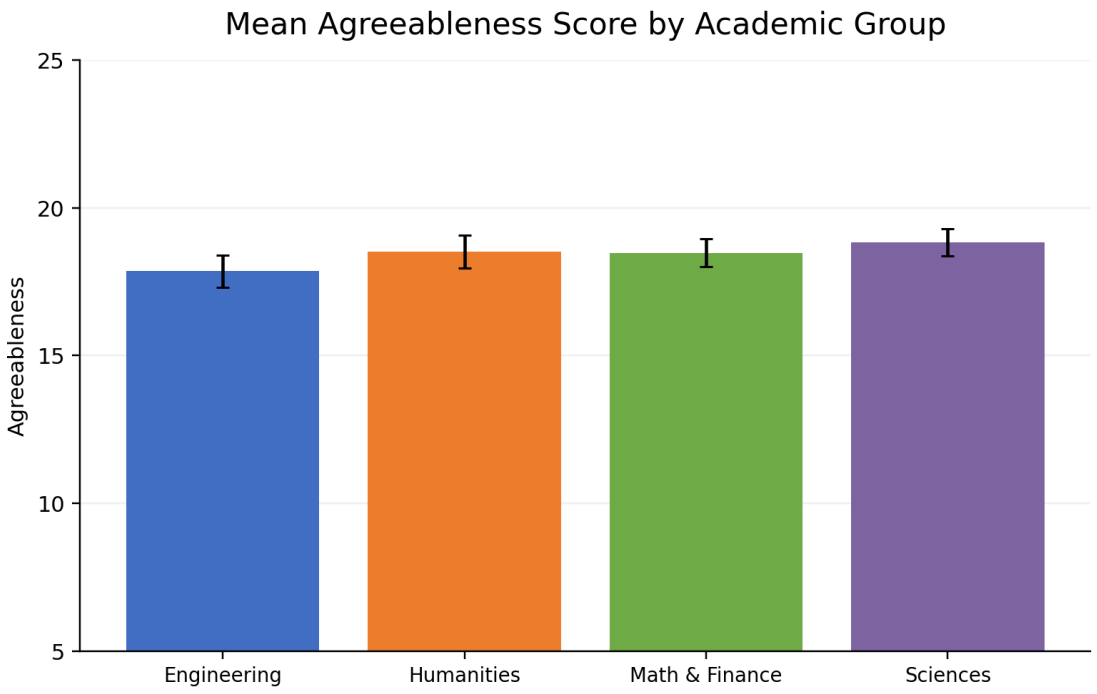


Figure 2. Mean Agreeableness Score by Academic Group. Overall group differences were not statistically significant, F(3, 90) = 0.65, p = 0.586. Error bars represent standard errors.

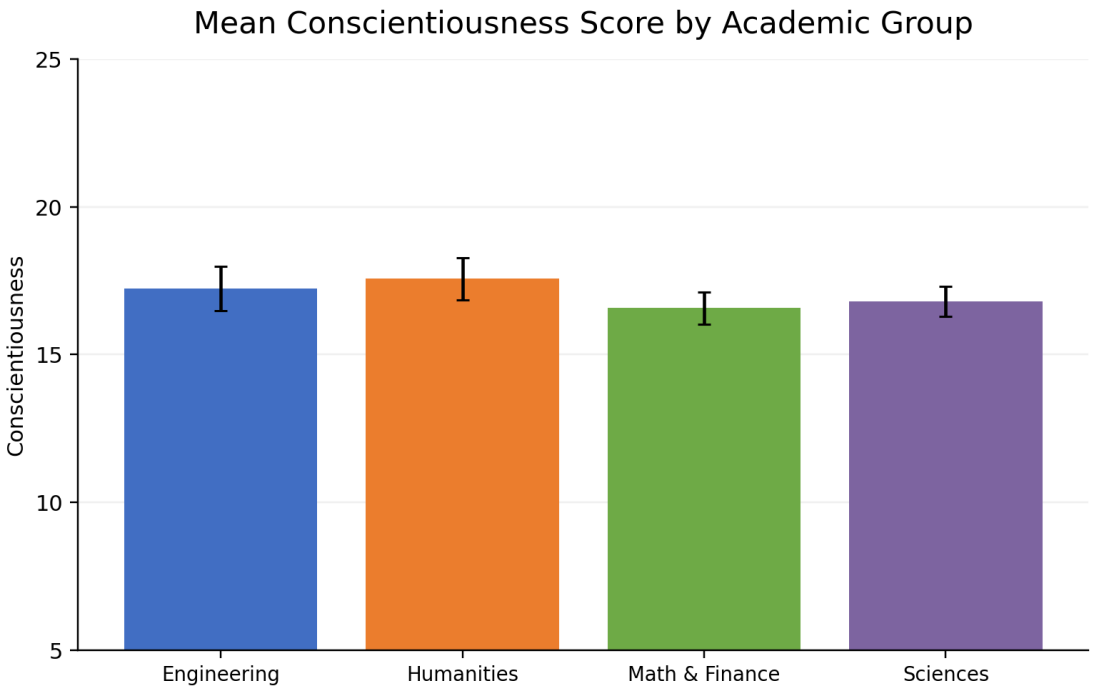


Figure 3. Mean Conscientiousness Score by Academic Group. Overall group differences were not statistically significant, F(3, 90) = 0.46, p = 0.713. Error bars represent standard errors.

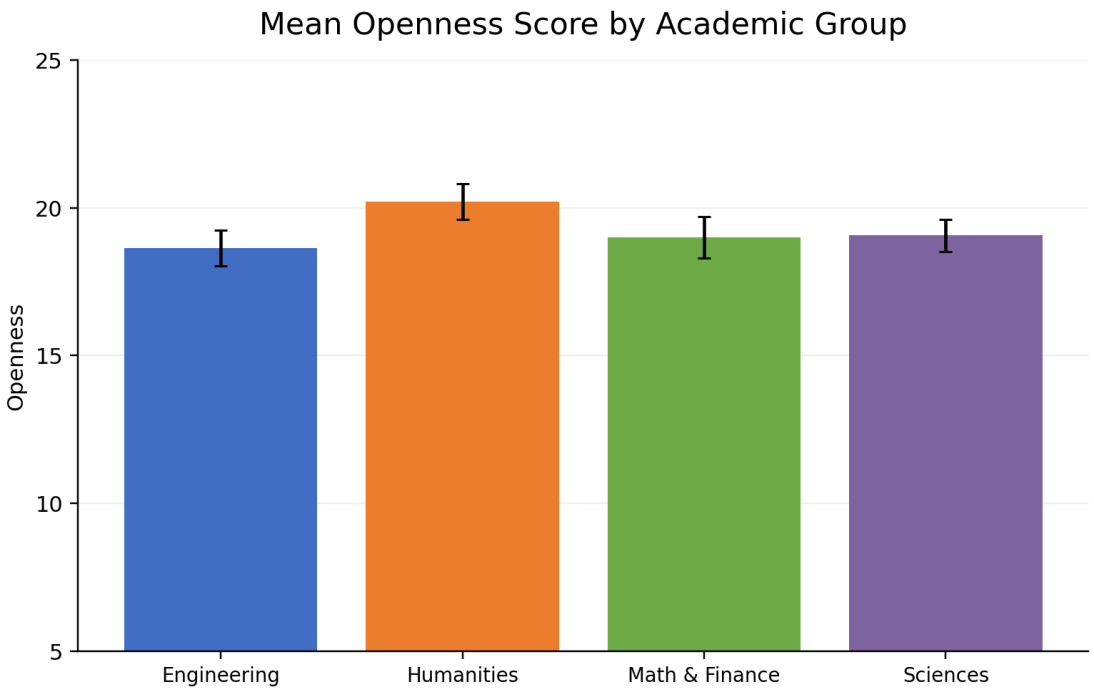


Figure 4. Mean Openness Score by Academic Group. Overall group differences were not statistically significant, F(3, 90) = 1.24, p = 0.298. Error bars represent standard errors.

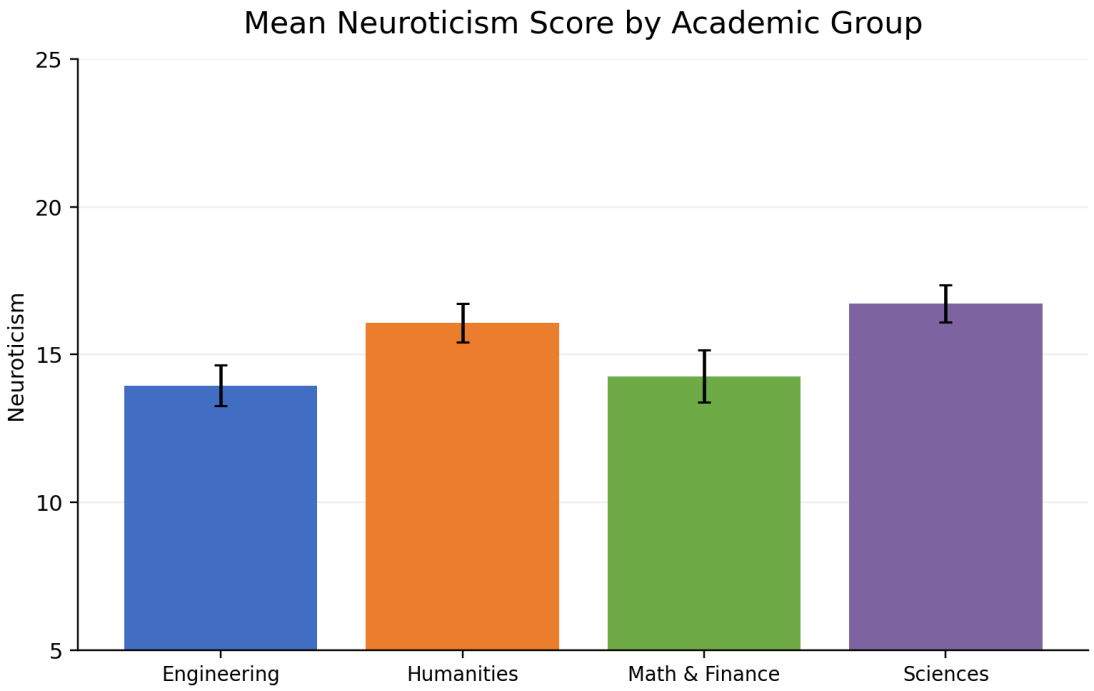


Figure 5. Mean Neuroticism Score by Academic Group. Overall group differences were significant, F(3, 90) = 3.88, p = .012. Error bars represent standard errors.

Personality and Academic Performance

Pearson correlations revealed significant associations between GPA and three personality traits. Conscientiousness was positively correlated with GPA, r = .243, p = .021, supporting the prediction that greater Conscientiousness would be associated with stronger academic performance. Extraversion was also positively associated with GPA, r = .233, p = .027. Neuroticism demonstrated a significant negative relationship with GPA, r = -.256, p = .015. Agreeableness showed only a weak positive relationship with GPA, r = .068, p = .521, while Openness was essentially unrelated to GPA, r = .007, p = .946. Figures 6-10 show the corresponding scatterplots and fitted linear trendlines.

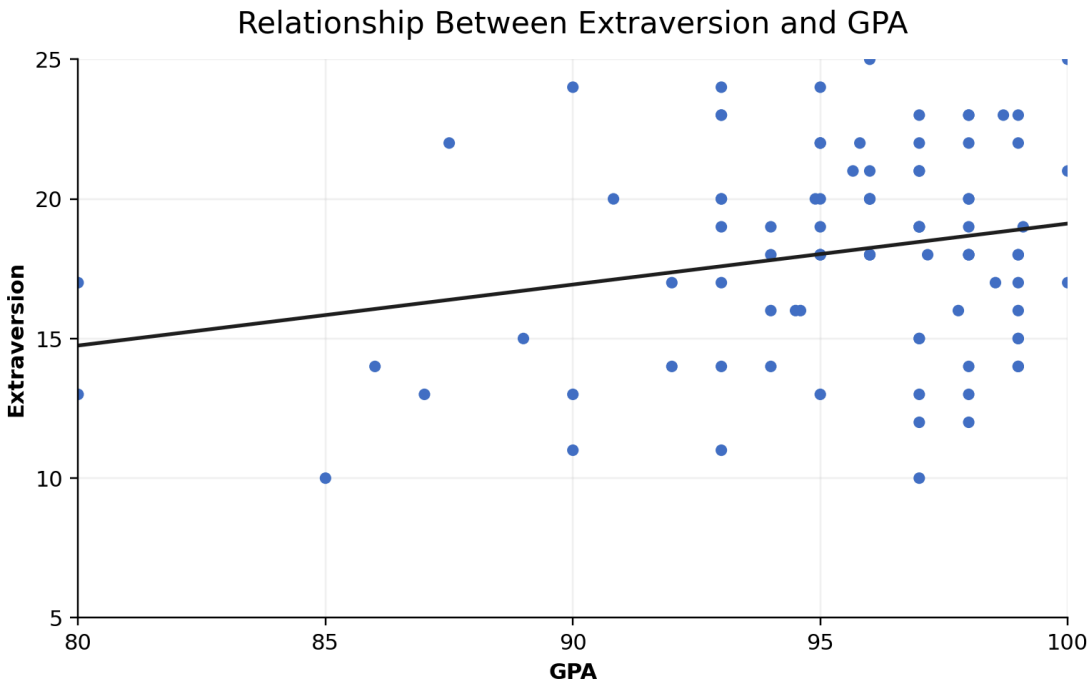


Figure 6. Relationship Between Extraversion and GPA. Extraversion was significantly positively associated with GPA, r = 0.233, p = 0.027.

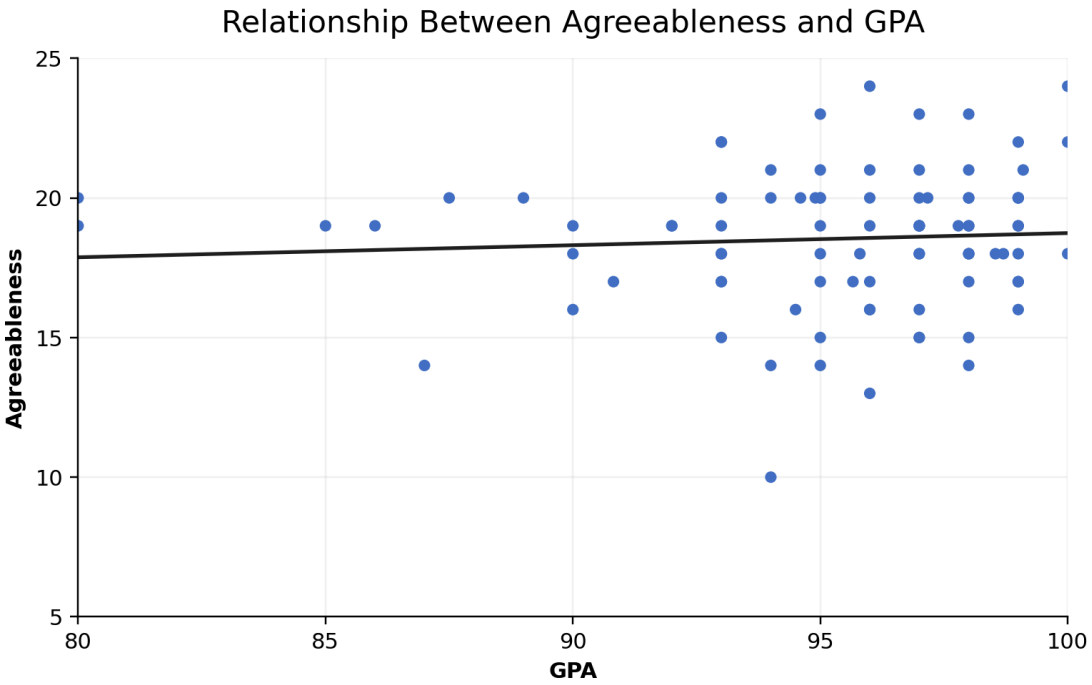


Figure 7. Relationship Between Agreeableness and GPA. Agreeableness was positively associated with GPA, r = 0.068, p = 0.521.

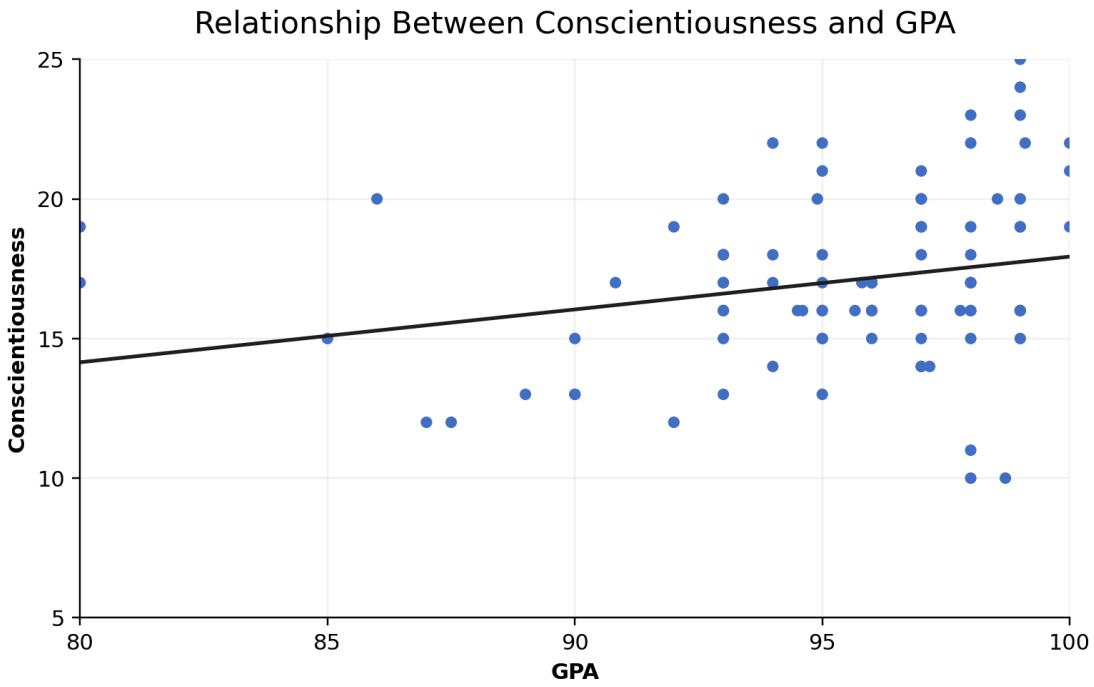


Figure 8. Relationship Between Conscientiousness and GPA. Conscientiousness was significantly positively associated with GPA, r = 0.243, p = 0.021.

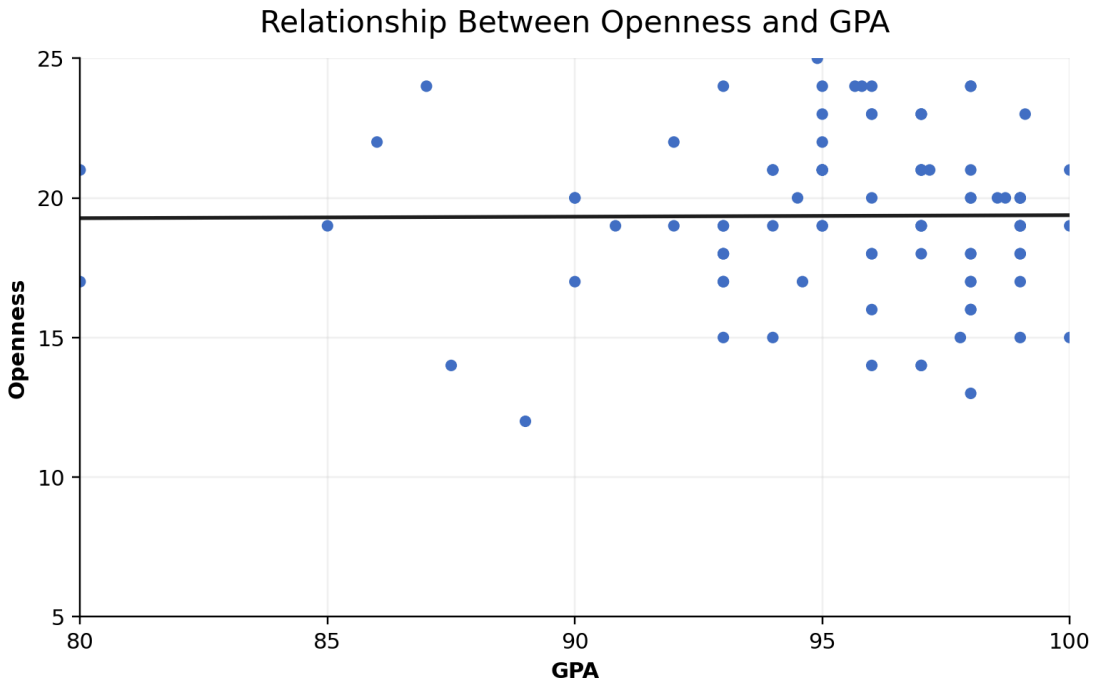


Figure 9. Relationship Between Openness and GPA. Openness was positively associated with GPA, r = 0.007, p = 0.946.

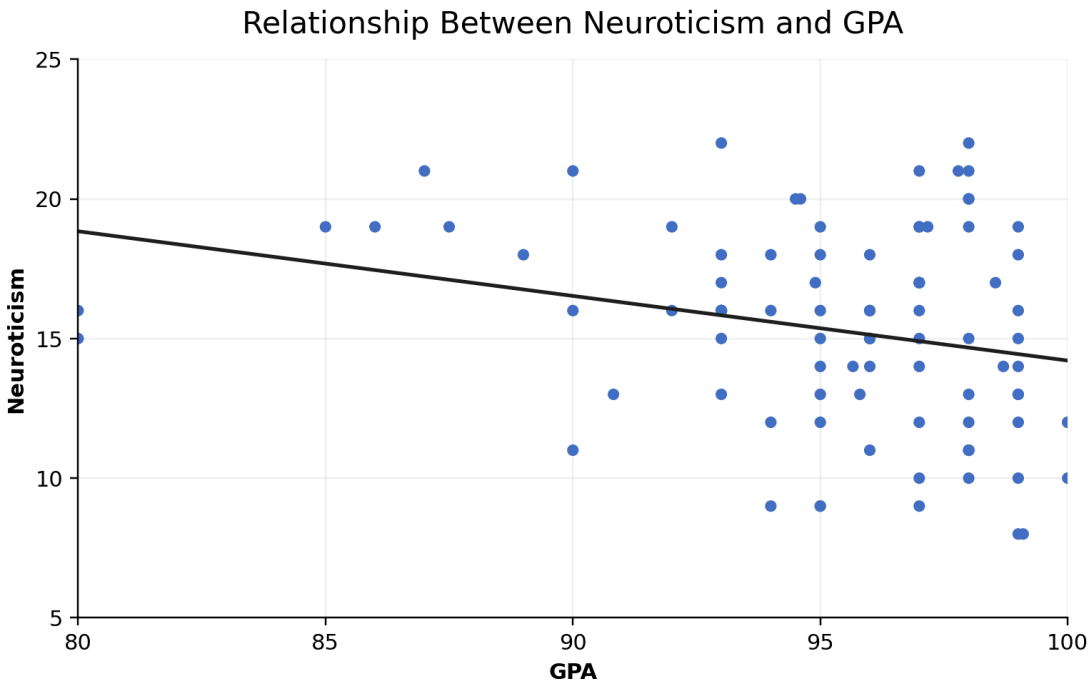


Figure 10. Relationship Between Neuroticism and GPA. Neuroticism was significantly negatively associated with GPA, r = -0.256, p = 0.015.

Discussion

The present study examined whether Big Five personality traits differed across specialized academic pathways among Brooklyn Technical High School students and whether personality was associated with GPA. The findings produced a mixed pattern. Neuroticism differed significantly across academic groups, but Extraversion, Agreeableness, Conscientiousness, and Openness did not. In contrast, three traits demonstrated significant relationships with academic performance: Conscientiousness and Extraversion were positively associated with GPA, while Neuroticism was negatively associated with GPA.

The limited personality differentiation across academic groups contrasts with much of the university literature. Vedel's (2016) systematic review found that 11 of 12 studies reported significant differences in at least one Big Five trait across university majors and that medium-sized differences occurred frequently. One interpretation of the present findings is therefore that personality differences associated with academic specialization may be less developed during high school than among university students.

This interpretation is consistent with the developmental stage of the participants, although the present cross-sectional data cannot directly demonstrate developmental change. Klimstra et al. (2012) found longitudinal relationships between Big Five personality traits and educational identity formation during late adolescence. Brooklyn Tech students have made meaningful educational choices but remain in a period during which personality and educational identity continue to develop. The differentiation observed among university majors could therefore

reflect both initial personality-based selection and continued development following sustained exposure to different educational environments.

Person-environment fit provides a related explanation. Students may initially select academic environments compatible with their interests and characteristics, but university students subsequently spend several years immersed within those environments. Academic specialization may expose students to increasingly different activities, peers, expectations, and occupational pathways. Consequently, personality differences across fields could become more pronounced as educational trajectories progress.

However, the nonsignificant findings should not be interpreted as evidence that no personality differences exist. The sample contained 94 students, meaning that relatively small group differences may have been difficult to detect. Furthermore, consolidating numerous individual Brooklyn Tech majors into four categories may have obscured distinctions between particular disciplines.

Openness provides a useful example. Humanities students recorded the highest mean Openness score (20.22), compared with Sciences (19.07), Math & Finance (19.00), and Engineering (18.64). Vedel's (2016) systematic review found arts and humanities students consistently high in Openness and reported some of the largest personality differences across disciplines for this trait. The direction of the present result therefore corresponded with previous research and the original hypothesis, but the difference was not sufficiently large relative to within-group variation to reach statistical significance. It should be interpreted as a descriptive pattern rather than confirmation of the hypothesis.

Neuroticism produced the clearest evidence of personality differentiation. Sciences students recorded the highest mean score, followed by Humanities, Math & Finance, and Engineering. Vedel (2016) also found relatively high Neuroticism among arts/humanities and psychology students, showing that Neuroticism has differed across academic disciplines in previous research. The present result has some precedent, although further research is needed before interpreting the particular ordering observed at Brooklyn Tech.

Neuroticism also demonstrated a significant negative relationship with GPA ($r = -.256$). Students reporting greater tendencies toward negative emotionality, worry, and stress sensitivity tended to report lower academic performance. This relationship does not establish causation. Greater negative emotionality could interfere with academic functioning, academic difficulty could contribute to stress and negative emotion, or both could reflect other factors not measured in the study.

The Conscientiousness finding provides the clearest replication of established academic-performance research. Conscientiousness was positively correlated with GPA ($r = .243$). Vedel's (2014) meta-analysis found a weighted Conscientiousness-GPA correlation of $r = .26$ across tertiary students. The similarity in magnitude is noteworthy: despite the younger and more specialized sample in the present study, the observed association was close to the meta-analytic estimate. This supports the hypothesis that characteristics associated with Conscientiousness, such as organization, persistence, and goal-directed behavior, are relevant to academic performance.

Extraversion was also positively associated with GPA ($r = .233$), a relationship that was not a central prediction of the study. This finding requires further investigation. Possible mechanisms

include classroom participation, help-seeking, collaboration, or broader engagement with school, but none of these behaviors were directly measured. The result should therefore be presented as an empirical finding rather than explained through unsupported assumptions.

Taken together, the GPA and major results suggest a potentially important distinction. Personality may already be related to how students function academically during adolescence even when it is less strongly associated with which academic pathway they select. Conscientiousness, Extraversion, and Neuroticism were significantly associated with GPA, yet only Neuroticism significantly differentiated academic groups.

Limitations and Future Research

Several limitations qualify these conclusions. First, the sample consisted of 94 students from one specialized high school, limiting generalizability. Brooklyn Tech students are selected into an academically demanding environment and may not represent high-school students generally.

Second, the study was cross-sectional. It cannot distinguish whether personality influences educational choices, whether academic environments contribute to personality development, or whether both processes occur simultaneously.

Third, personality was assessed using a researcher-developed 25-item questionnaire rather than a previously validated standardized Big Five inventory. Although the questionnaire was structured around the established Big Five framework, the particular measure has not undergone independent psychometric validation. Future research should replicate the findings using a validated Big Five instrument.

Fourth, combining individual majors into four broad groups increased statistical feasibility but reduced disciplinary specificity. A larger sample would permit individual majors to be examined separately.

Future research would benefit particularly from a longitudinal design beginning before students select their Brooklyn Tech majors and following them through high school and potentially into university. Such a design could determine whether personality predicts subsequent academic selection and whether personality differences across academic disciplines become larger following sustained exposure to specialized environments.

Conclusion

The present study examined Big Five personality traits, academic specialization, and GPA among 94 students at Brooklyn Technical High School. Contrary to expectations derived largely from university research, Extraversion, Agreeableness, Conscientiousness, and Openness did not differ significantly across academic groups, although Humanities students demonstrated the predicted descriptive tendency toward greater Openness. Neuroticism was the only personality trait that differed significantly across academic specializations. Personality demonstrated clearer relationships with academic performance: higher Conscientiousness and Extraversion were significantly associated with higher GPA, while greater Neuroticism was associated with lower GPA. These results suggest that personality characteristics associated with academic performance may already be evident during adolescence, while stronger personality differentiation across academic disciplines may emerge or strengthen later in students' educational trajectories.

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