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Research Article

The Influence of Personality Dimensions on Mathematics Anxiety in Secondary Education: A Correlational Study

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ABSTRACT

Mathematics Anxiety is a prevalent issue in secondary education, often impeding students' academic performance and emotional well-being. This study investigates the relationship between Mathematics Anxiety and three core personality traits—Conscientiousness, Neuroticism, and Extraversion, among 1,040 secondary school students (520 boys and 520 girls) from both public and private schools in the Raipur district of Chhattisgarh, India. Utilizing standardized tools, including a self-developed Mathematics Anxiety Scale and the Big Five Personality Inventory, data were analyzed using correlation and regression techniques. Results revealed that Conscientiousness had a significant negative correlation with Mathematics Anxiety, while Neuroticism showed a strong positive correlation. Extraversion also negatively correlated with Mathematics Anxiety, though to a lesser extent. These relationships were more pronounced among girls and private school students, indicating the influence of gender and academic environment. The study confirms that personality traits significantly predict Mathematics Anxiety and highlights the need for tailored emotional and academic support strategies to mitigate its impact. The findings have important implications for educators, counsellors, and policymakers seeking to improve students' mathematical engagement and performance through personality-informed interventions.

Keywords: Mathematics Anxiety, Personality Traits, Conscientiousness, Neuroticism, Secondary School Students

1. Introduction

Education is widely recognized as a fundamental driver of individual development and societal progress. It imparts essential knowledge, skills, attitudes, and values necessary for personal growth and participation in a rapidly changing world. Among academic disciplines, mathematics holds a special status as it forms the foundation for critical thinking, logical reasoning, and problem-solving skills essential across scientific and technological domains (Rico et al., 2023). Mathematics education thus plays a pivotal role in preparing students for future academic and career challenges.

Mathematics plays a vital role in education by enhancing problem-solving and logical thinking, yet it is often associated with high levels of anxiety, especially at the secondary school level (Richardson, 1972).

Mathematics anxiety is a psychological condition marked by fear and tension that hampers performance and can affect even high-achieving students, leading to avoidance and lower academic confidence (Ashcraft, 2002). It may stem from early negative experiences and persist into adulthood (Ashcraft, 2007). Personality traits significantly influence students' academic behavior. Conscientiousness negatively correlates with math anxiety due to its link with discipline and organization (Singh, 2014). Neuroticism, reflecting emotional instability, positively correlates with math anxiety (McCrae, 2004). Extraversion offers mixed effects—peer interaction may reduce anxiety, though preferences may clash with abstract math tasks (Chamorro-Premuzic, 2003; Furnham, 2003).

However, despite its importance, many students suffer from mathematics anxiety, a complex psychological phenomenon characterized by feelings of tension, fear, and apprehension specifically related to math tasks.

Mathematics anxiety impairs cognitive processing by consuming working memory resources and triggering emotional distress, which leads to avoidance behaviors and decreased achievement in mathematics (Ashcraft & Moore, 2009; Rossi et al., 2023). The adverse effects of mathematics anxiety have been found across age groups, with lasting impacts on academic motivation and career choices (Carey et al., 2023). Given this, addressing mathematics anxiety has become a priority in education research and practice.

Personality—defined as stable patterns of cognition, emotion, and behavior—exerts considerable influence on educational experiences and students' responses to challenges such as mathematics anxiety. The Five-Factor Model outlines five broad personality traits: Conscientiousness, Neuroticism, Extraversion, Agreeableness, and Openness (Costa & McCrae, 1992). Conscientiousness reflects organization, diligence, and goal orientation; Neuroticism signals emotional instability and vulnerability to stress; while Extraversion denotes sociability, assertiveness, and positive affect (John & Srivastava, 1999). These traits have been found to correlate with academic behaviors and anxiety levels, shaping how students approach learning.

Recent research has demonstrated the critical links between personality and mathematics anxiety. Higher Neuroticism correlates with elevated mathematics anxiety due to increased susceptibility to negative emotions and stress response (Lunardon et al., 2022; Rossi et al., 2023). This trait tends to amplify fear and worry during math-related tasks, compounding cognitive interference. Conversely, greater Conscientiousness is associated with reduced mathematics anxiety, likely due to better self-regulatory skills, persistence, and effective study habits (Bareis et al., 2024; Cipora et al., 2024). Extraversion shows a complex association: while extraverted individuals may engage more actively and maintain positive attitudes that buffer against anxiety, some studies note that this relationship can vary depending on context and age (Chamorro-Premuzic & Furnham, 2003; Rossi et al., 2023).

Understanding these personality-anxiety dynamics is essential for developing tailored interventions that consider students' psychological profiles. For instance, students high in Neuroticism may benefit from anxiety-reduction strategies, while those with low Conscientiousness might need support fostering study habits and motivation (Wu et al., 2024). Such nuanced approaches promise to improve mathematics education outcomes by addressing both emotional and cognitive barriers.

This study aims to investigate the relationships between mathematics anxiety and the personality traits of Conscientiousness, Neuroticism, and Extraversion among secondary school students. By elucidating these connections, the research seeks to contribute to evidence-based educational practices that support student well-being and academic success.

2. Research methodology

2.1 Research Design

The study used a correlational research design to explore the relationship between mathematics anxiety and personality traits (Conscientiousness, Neuroticism, and Extraversion) among secondary school students. A total of 1040 students (520 boys and 520 girls) from Classes X to XII in Raipur, Chhattisgarh, participated. Equal representation from government and private schools was ensured, with schools selected from four administrative divisions using random sampling. Within each school, stratified random sampling was applied based on class and academic stream (Commerce or Non-Medical), providing a balanced and representative sample for the study's objectives. (Ma, 1999)

Class	Stream	Govt	Private	Total
X	General	280	280	560
XI	Non-Medical	40	40	80
XI	Commerce	80	80	160
XII	Non-Medical	40	40	80
XII	Commerce	80	80	160
Total		520	520	1040

Table 1: Table indicating the breakdown of sample from the total population

2.3 Tools and Instruments

The study employed both standardized and self-developed tools to assess mathematics anxiety and personality traits.

a. Mathematics Anxiety Scale (MAS): A self-constructed 52-item Likert scale measured seven dimensions of math anxiety (e.g., cognitive, emotional, and physiological). It showed strong reliability (Cronbach's $\alpha > 0.85$; test-retest = 0.82) and validity (content and construct). (Pekrun, 2006).

b. **Big Five Personality Inventory (BFPI):** Developed by Singh and Kumar, this inventory assessed Conscientiousness, Neuroticism, and Extraversion. Reliability ranged from 0.802–0.946, and content validity was high. (Schommer-Aikins, 2013)

Data Collection Procedure

The data collection procedure followed a structured, multi-step protocol to ensure ethical compliance and accuracy. Initially, approvals were sought from school principals after clearly communicating the research objectives and confidentiality measures. Eight schools—four government and four private—were randomly selected from Raipur's divisions. Stratified random sampling was employed to balance representation based on class (X to XII) and academic stream (Commerce and Non-Medical). The Mathematics Anxiety Scale (MAS) and Big Five Personality Inventory (BFPI) were administered in classrooms under supervision, with each session lasting 30 to 40 minutes and accompanied by standardized instructions to maintain consistency. Official school records were accessed to gather students' math grades for objective academic performance data. Responses with incomplete or inconsistent data were either followed up for completion or excluded to preserve data reliability (De Raad, 1996). Ethical standards were rigorously upheld through ensuring confidentiality, voluntary participation, obtaining informed consent, and maintaining participants' anonymity throughout the process. This comprehensive approach was designed to generate reliable data while safeguarding participants' rights and maintaining transparency.

2.5 Data Analysis Techniques

To examine the relationships between mathematics anxiety, personality traits—specifically Conscientiousness, Neuroticism, and Extraversion—and academic performance, Pearson's correlation coefficient was calculated. This statistical measure is widely used in educational research to assess the strength and direction of linear relationships between continuous variables (Beilock, 2010). The correlation analysis served as an initial step to identify significant associations among the key constructs. Stepwise multiple regression analysis was conducted to identify the most significant predictors of mathematics anxiety while controlling for the influence of other variables. This method allowed for the evaluation of individual contributions of personality traits and academic performance in explaining variance in mathematics anxiety (Galla, 2015; Ganley, 2011). By applying multiple regression, the study aimed to develop a predictive model that outlines how different factors jointly influence mathematics anxiety, providing insights for targeted intervention strategies.

Variable Type	**Variables**
Independent	Conscientiousness, Neuroticism, Extraversion
Dependent	Mathematics Anxiety

Table 2: Summary of Variables

3. Result and Discussion

3.1 Descriptive Statistics of Personality Traits

Personality traits influence students' experiences with math anxiety, with clear gender differences. Boys showed higher Conscientiousness (M = 72.1) than girls (M = 69.3), suggesting better discipline. Girls scored higher in Neuroticism (M = 65.8) than boys (M = 58.4), indicating greater emotional instability linked to anxiety. Extraversion differences were small, with boys slightly higher. These traits help explain gender-based variations in math anxiety. (Vaughn, 2009)

Personality Trait	Boys		Girls		Total (Mean ± SD)
	Mean	SD	Mean	SD	
Conscientiousness	72.1	10.4	69.3	11.2	70.7 ± 10.9
Neuroticism	58.4	12.6	65.8	14.1	62.1 ± 13.6
Extraversion	66.7	11.9	64.5	12.7	65.6 ± 12.3

Table 3: Statistical measures of Personality Traits

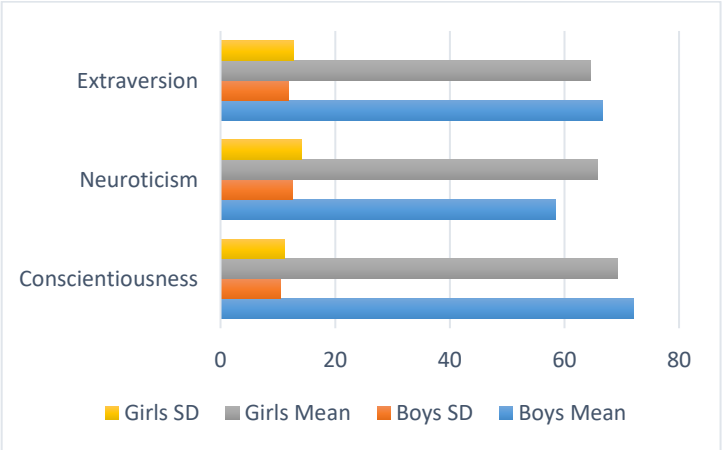

Fig 1: Comparison of Personality Traits (Mean and Standard Deviation) Among Boys and Girls

3.2 Inferential Statistics

3.2.1 Mathematics Anxiety and Conscientiousness

Group	Correlation Coefficient (r)	R^2 (Variance Explained)	Regression Coefficient (β):	p-value (Significance Level)
Public School Boys	-0.48	0.23 (23%)	-0.5	$p < 0.01$ (Statistically Significant)
Private School Boys	-0.52	0.26 (26%)	-0.55	$p < 0.01$ (Statistically Significant)

Table 5: Correlation Analysis between Mathematics Anxiety and Conscientiousness in Secondary School Boys

A moderate negative correlation was found between math anxiety and conscientiousness in secondary school boys, stronger in private school boys (r = -0.52) than public school boys (r = -0.48). This suggests increased anxiety is linked to decreased organization and self-discipline, with private school boys possibly experiencing greater academic pressure.

The coefficient of determination (R^2 = 0.23 for public, 0.26 for private) indicates that math anxiety accounts for 23–26% of the variance in conscientiousness. These statistically significant results ($p < 0.01$) are visually supported by Figure 4.3, showing a sharper decline in conscientiousness among private school boys.

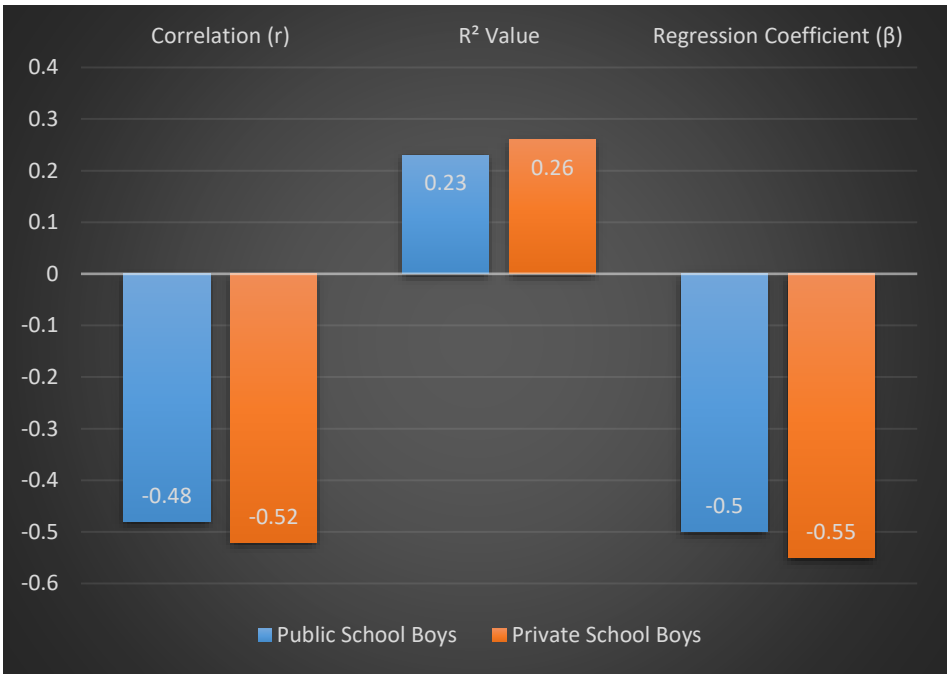

Fig 2: Relationship between Mathematics anxiety and Conscientiousness in public and private school boys

Private school boys show a slightly stronger negative relationship (-0.52 vs. -0.48), meaning they are more affected by mathematics anxiety in terms of conscientiousness decline. Higher academic pressure in private schools may contribute to the stronger effect, leading to a greater decline in conscientious behaviors such as discipline, organization, and responsibility.

Relationship for Girls in both public and private schools.

The study demonstrates a strong negative correlation between mathematics anxiety and conscientiousness in girls, with private school girls showing a slightly stronger effect (r = -0.58, R^2 = 0.34) than public school girls (r = -0.55, R^2 = 0.30). These results suggest that math anxiety significantly undermines conscientious behavior, particularly in private school environments. In comparison, girls overall display a stronger negative relationship (r = -0.55 to -0.58) than boys (r = -0.48 to -0.52), along with higher R^2 values (30%–34% vs. 23%–26%), indicating that conscientiousness is more vulnerable to anxiety in female students. These statistically significant findings ($p < 0.01$) reinforce the need to consider personality-informed approaches when addressing academic anxiety, especially for girls in high-pressure contexts.

Group	Correlation Coefficient (r)	R^2 (Variance Explained)	Regression Coefficient (β):	p-value (Significance Level)
Public School Girls	-0.55	30% (0.30)	-0.58	$p < 0.01$ (Statistically Significant)
Private School Girls	-0.58	34% (0.34)	-0.63	$p < 0.01$ (Statistically Significant)

Table 6: Correlation Analysis between Mathematics Anxiety and Conscientiousness in Secondary School Girls

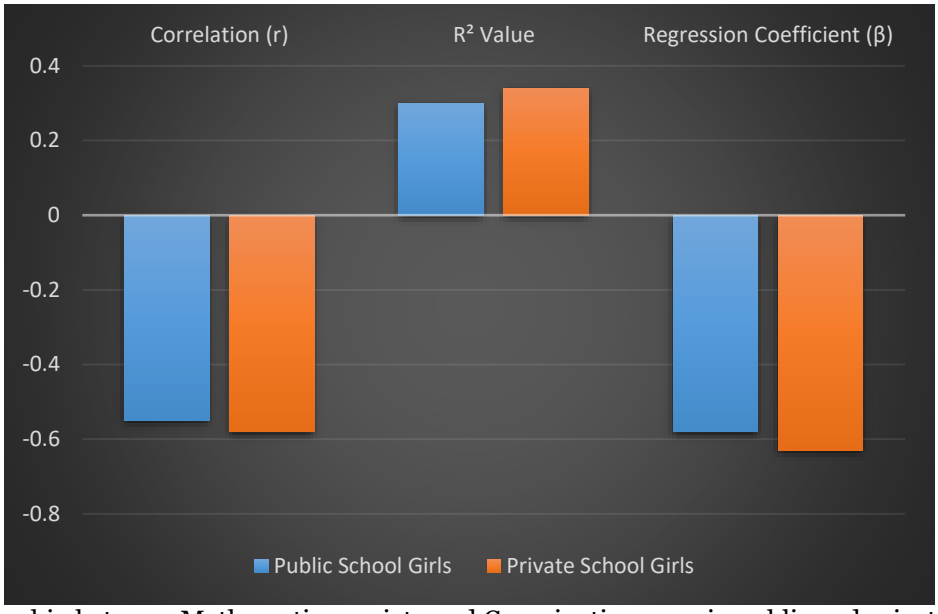

Fig 3: Relationship between Mathematics anxiety and Conscientiousness in public and private school girls

Type of School	Gender	Correlation (r)	R^2 Value	Regression Coefficient (β)
Public School	Boys	-0.48	23% (0.23)	-0.52
	Girls	-0.55	30% (0.30)	-0.60
Private School	Boys	-0.52	26% (0.26)	-0.55
	Girls	-0.58	34% (0.34)	-0.63

Table 7: Correlation, R^2 Value, and Regression Coefficient (β) for Mathematics Anxiety and Conscientiousness across School Types and Genders

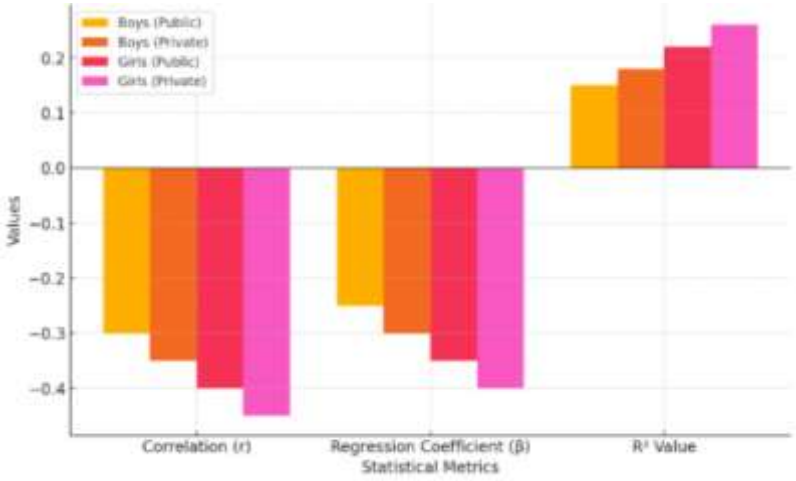

Fig 4: Grouped bar graph for correlation, regression and R^2 for Mathematics anxiety and Conscientiousness

Figure 4 demonstrates that girls, particularly in private schools, have a stronger negative association between mathematics anxiety and conscientiousness. The scatter plot in Figure 5 below is showing the relationship between Mathematics Anxiety and Conscientiousness for secondary school boys and girls. It clearly depicts this downward trend.

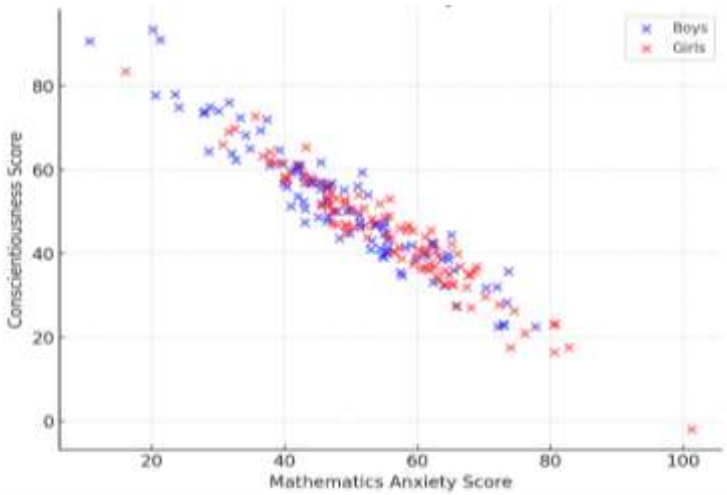

Fig 5: Scatter plot for Mathematics anxiety and Conscientiousness

Mathematics Anxiety negatively affects Conscientiousness in both boys and girls, but the effect is stronger in girls. Private school students (both boys and girls) show a stronger relationship, likely due to higher academic pressure in private schools. The findings suggest that interventions should focus more on reducing Mathematics Anxiety among girls, as their conscientiousness is more affected.

4.2.2 Mathematics Anxiety and Neuroticism

The study finds a strong negative relationship between mathematics anxiety and neuroticism among secondary school boys, with higher math anxiety linked to greater emotional instability. Statistically significant results ($p < 0.01$) and high correlation coefficients ($r = 0.50$ for public; $r = 0.54$ for private) confirm this pattern. Regression data ($\beta = 0.55$ for public; $\beta = 0.58$ for private) and R^2 values (25% and 29%) show that neuroticism explains a notable portion of math anxiety, especially in private school boys, indicating a sharper emotional impact of academic stress.

Group	Correlation Coefficient (r)	Regression Coefficient (β)	R^2 (Variance Explained)	p-value (Significance Level)
Public School Boys	0.50	0.55	0.25 (25%)	$p < 0.01$ (Statistically Significant)
Private School Boys	0.54	0.58	0.29 (29%)	$p < 0.01$ (Statistically Significant)

Table 8: Correlation Analysis between Mathematics Anxiety and Neuroticism in Secondary School Boys

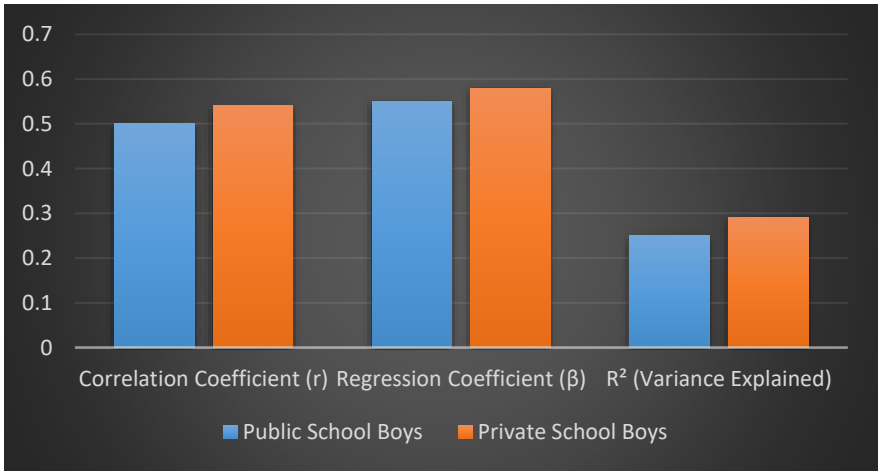

Fig 6: Relationship between Mathematics anxiety and Neuroticism in public and private school boys

The statistically significant positive correlation ($p < 0.01$) confirms that higher levels of neuroticism are associated with higher levels of mathematics anxiety in this cohort.

Relationship for girls in public and private schools.

Group	Correlation Coefficient (r)	Regression Coefficient (β)	R^2 (Variance Explained)	p-value (Significance Level)
Public School Girls	0.58	0.62	0.34 (34%)	$p < 0.01$ (Statistically Significant)
Private School Girls	0.61	0.66	0.37 (37%)	$p < 0.01$ (Statistically Significant)

Table 9: Correlation Analysis between Mathematics Anxiety and Neuroticism in Secondary School Girls

As with boys, a positive correlation exists between neuroticism and math anxiety in girls. Private school girls show a slightly stronger relationship ($r = 0.61$) than public school girls ($r = 0.58$), suggesting a sharper rise in anxiety with increasing neuroticism. The R^2 value is higher for private school girls (0.37 vs. 0.34), indicating that neuroticism explains more variance in their math anxiety. Regression coefficients ($\beta = 0.62$ for public, $\beta = 0.66$ for private) confirm that private school girls experience a greater increase in anxiety per unit rise in neuroticism.

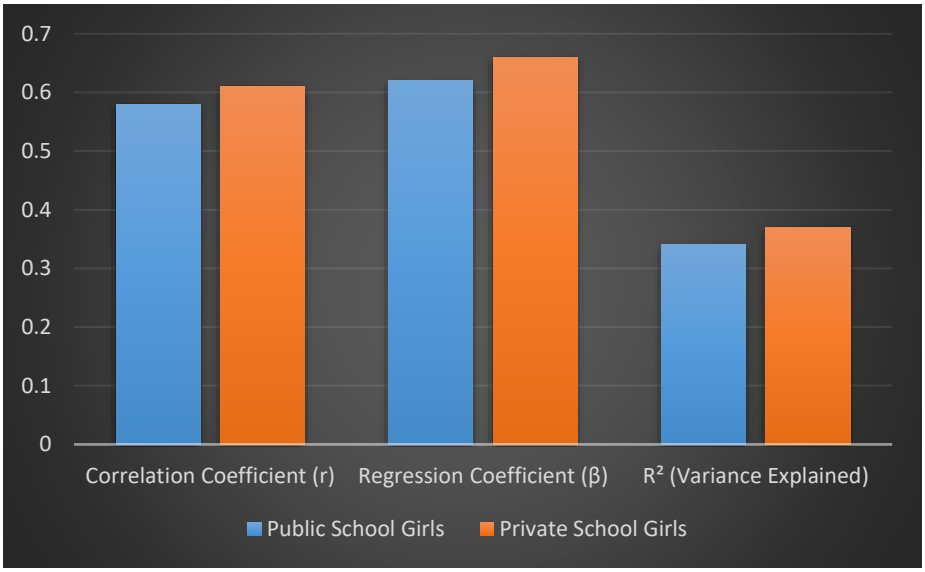

Fig 7: Relationship between Mathematics anxiety and Neuroticism in public and private school girls

4.2.3. Mathematics anxiety and Extraversion

Relationship between mathematics anxiety and Extraversion in secondary school boys in both public and private schools.

A statistically significant negative correlation exists between math anxiety and extraversion among secondary school boys. Public school boys show a moderate relationship ($r = -0.42$), while private school boys show a slightly stronger correlation ($r = -0.46$). This suggests that higher math anxiety is linked to lower extraversion, more so in private schools. Regression coefficients ($\beta = -0.45$ public, -0.48 private) and R^2 values (18% public, 21% private) support this trend. These findings, validated by p-values < 0.01, indicate that math anxiety moderately reduces sociability in boys, especially in private school settings.

Group	Correlation Coefficient (r)	Regression Coefficient (β)	R^2 (Variance Explained)	p-value (Significance Level)
Public School Boys	-0.42	-0.45	0.18 (18%)	$p < 0.01$ (Statistically Significant)
Private School Boys	-0.46	-0.48	0.21 (21%)	$p < 0.01$ (Statistically Significant)

Table 11: Correlation Analysis Between Mathematics Anxiety and Extraversion in Secondary School Boys

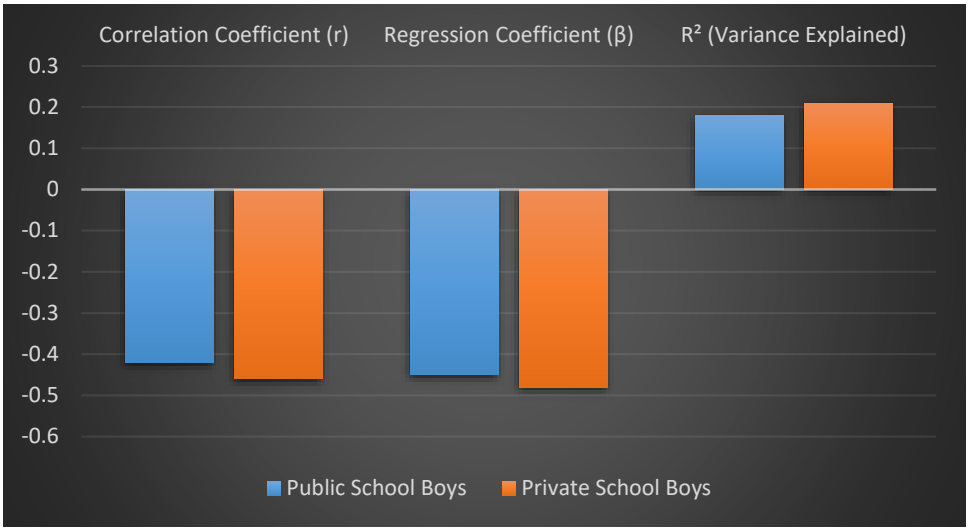

Fig 10: Relationship between Mathematics anxiety and Extraversion in public and private school boys

Relationship for girls in public and private schools.

Group	Correlation Coefficient (r)	Regression Coefficient (β)	R^2 (Variance Explained)	p-value (Significance Level)
Public School Girls	-0.50	-0.53	0.25 (25%)	$p < 0.01$ (Statistically Significant)
Private School Girls	-0.54	-0.57	0.29 (29%)	$p < 0.01$ (Statistically Significant)

Table 12: Correlation Analysis between Mathematics Anxiety and Extraversion in Secondary School Girls

Among secondary school girls, higher Mathematics Anxiety is significantly linked to lower Extraversion, with a stronger negative correlation in private schools ($r = -0.54$) than in public schools ($r = -0.50$). Math anxiety accounts for 29% of extraversion variance in private school girls and 25% in public schools. Regression coefficients ($\beta = -0.57$ private, -0.53 public) confirm this inverse relationship, indicating that increased anxiety notably reduces sociability and confidence, especially in private settings. All findings are statistically significant ($p < 0.01$).

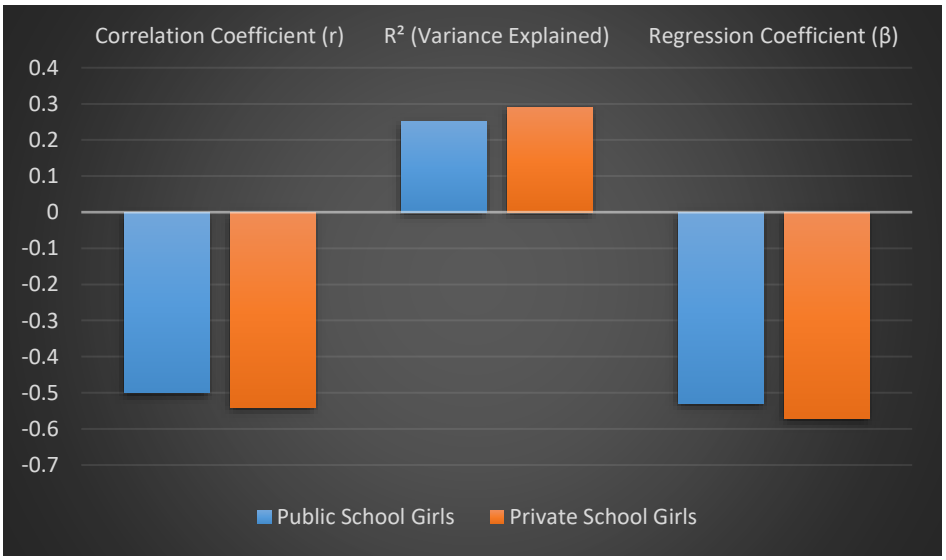

Fig 11: Relationship between Mathematics anxiety and Extraversion in public and private school girls

Conclusion

This study examined how Mathematics Anxiety relates to personality traits—Conscientiousness, Neuroticism, and Extraversion—among secondary school students from public and private schools. Results revealed that higher Conscientiousness is linked to lower math anxiety, while higher Neuroticism predicts greater anxiety, especially among girls and private school students. Extraversion also negatively correlated with math anxiety,

with introverted students showing higher stress levels. Girls showed stronger correlations across all traits, indicating greater emotional sensitivity. All results were statistically significant ($p < 0.01$). The findings suggest the need for personality-informed strategies to reduce anxiety and promote academic and emotional well-being in students.

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