# Gender Achievement Gaps in Maths and English: The Role of Cognitive and Non-Cognitive Skills

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## I. Introduction

In my analysis of Junior Certificate examination scores in Ireland, I investigate how cognitive abilities and personality traits shape academic achievement differences between boys and girls. Despite decades of progress in educational equality, persistent gender gaps in academic performance continue to raise important questions about human capital development and educational effectiveness. These gaps, particularly pronounced in Maths and English, may have lasting implications for career choices, labor market outcomes, and broader economic inequality.

My research reveals consistent gender-based patterns across socioeconomic groups and identifies important interactions between cognitive abilities, non-cognitive traits, and academic performance. The findings suggest that while boys tend to outperform girls in Maths and girls excel in English, these patterns are mediated by various factors including household income, parental education, and personality traits. Understanding these relationships is crucial for developing targeted educational interventions and policies that can better support both boys' and girls' academic development.

This study contributes to the existing literature by:

- Examining how cognitive and non-cognitive factors differently affect boys' and girls' academic performance,
- Analyzing the role of socioeconomic status in mediating gender achievement gaps, and
- Providing evidence-based insights for educational policy design in Ireland and beyond.

## II. Literature Review

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## III. Data Description

This analysis uses data from the Growing Up in Ireland (GUI) longitudinal study, specifically focusing on the '98 Cohort during Waves 2 and 3. The study collected independent variables, including cognitive and non-cognitive measures, during Wave 2 (August 2011 to March 2012) when children were approximately 13 years old. The Junior Certificate examination was taken between June 2013 and June 2014 when students were 15-16 years old, and these scores were collected as dependent variables during Wave 3 (April 2015 to August 2016) when participants were 17-18 years old.

Cognitive ability is measured through a composite variable created using principal component analysis of three measures from Wave 2: the Drumcondra Verbal Reasoning test (measuring naming and vocabulary skills), the Drumcondra Numerical Ability test, and the British Ability Scales Matrices test. This composite measure is standardized with a mean of 100 and a standard deviation of 15, following standard practice in the literature.

The analysis employs two different scales to measure non-cognitive skills. The Strengths and Difficulties Questionnaire (SDQ) assesses behavioral and emotional aspects through four dimensions: Emotional Symptoms, Conduct Problems, Hyperactivity/Inattention, and Peer-relationship Problems. The original SDQ scales were inverted so that higher scores indicate fewer problems. For Emotional Symptoms, higher scores indicate fewer instances of headaches, stomachaches, worries, unhappiness, nervousness, and fears. In the case of Hyperactivity/Inattention, higher scores represent better attention control - specifically, more instances of thinking before acting, seeing tasks through to completion, and maintaining good attention span, rather than restlessness, fidgeting, or being easily distracted.

The Ten-Item Personality Inventory (TIPI) measures the Big Five personality traits: Agreeableness, Conscientiousness, Emotional Stability, Extraversion, and Openness. These scores range from 1 to 7 in intervals of 0.5. High scores in Conscientiousness indicate being more dependable, self-disciplined, and organized, while high scores in Emotional Stability reflect being calm, relaxed, and emotionally stable. These scales maintained their original scoring format.

# IV. Socioeconomic Patterns in Gender Achievement Gaps

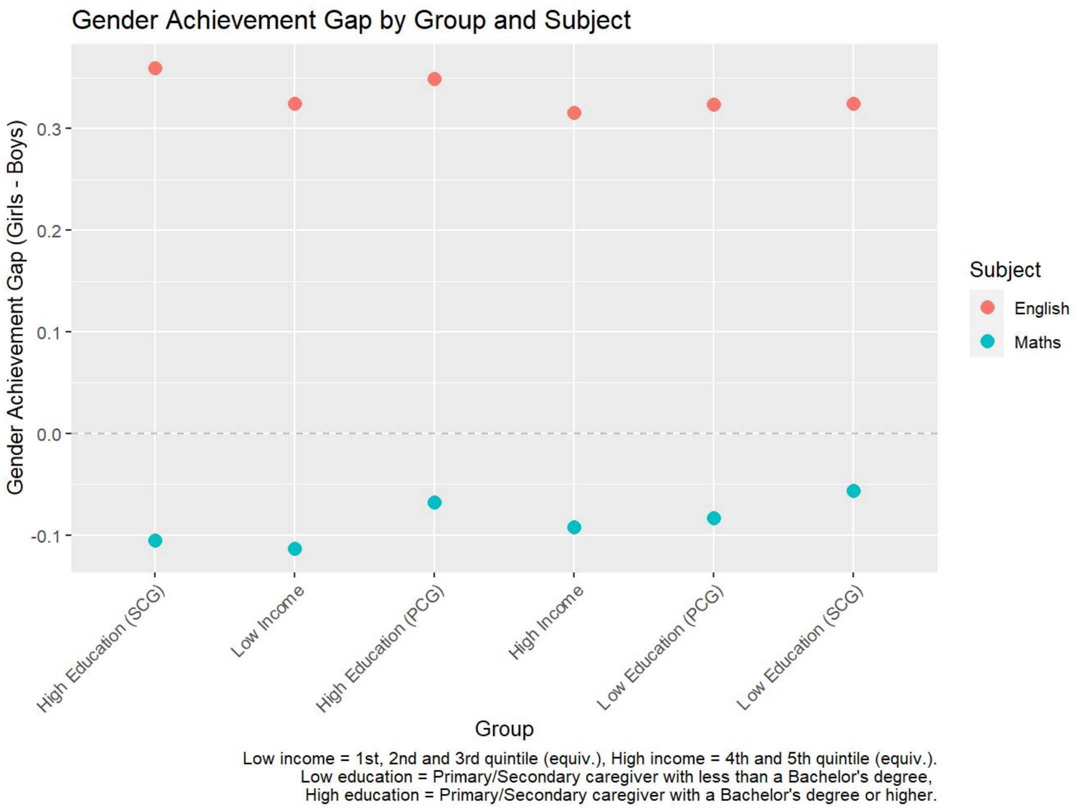


Figure 1: Gender Achievement Gap by Socioeconomic Group and Subject

I began by creating two separate datasets, one for English scores and one for Maths scores. In each dataset, I included mean scores for girls and boys across different socioeconomic groups. These groups were based on household income levels (low income: 1st, 2nd, and 3rd quintiles; high income: 4th and 5th quintiles) and parental education levels (low education: less than a Bachelor's degree; high education: Bachelor's degree or higher). Next, I calculated the gender achievement gap for each group and subject. To do this, I subtracted the boys' mean score from the girls' mean score for each socioeconomic group in both English and Maths. This gave me a single value representing the gender gap, where a positive number meant girls outperformed boys, and a negative number meant boys outperformed girls. That is represented in Figure 1.

## A. Results

Results show that across all income and education groups, boys outperform girls in Maths, and girls outperform boys in English. The achievement gap is also always smaller (in absolute values) in Maths than in English.

### 1. Maths Performance

The most pronounced gender gap in Maths appears in low-income groups (-0.113), while it reaches its narrowest point in households where the primary caregiver (typically the mother) has attained higher education (-0.069). Across all socioeconomic groups, higher income and

| **Maths: Group Data** | | | | | |
|---|---|---|---|---|---|
| Group | Girls Mean | Boys Mean | Gender Gap | Overall Mean | Gender Ratio |
| Low Income | 9.235 | 9.348 | -0.113 | 9.292 | 0.988 |
| High Income | 10.075 | 10.167 | -0.092 | 10.121 | 0.991 |
| Low Education (PCG) | 9.371 | 9.454 | -0.083 | 9.413 | 0.991 |
| High Education (PCG) | 10.322 | 10.390 | -0.069 | 10.356 | 0.993 |
| Low Education (SCG) | 9.389 | 9.444 | -0.056 | 9.417 | 0.994 |
| High Education (SCG) | 10.333 | 10.438 | -0.105 | 10.386 | 0.990 |
| **Maths: Socioeconomic Effects** | | | | | |
| Income Effect | | | 0.022 | 0.829 | |
| PCG Education Effect | | | 0.014 | 0.943 | |
| SCG Education Effect | | | -0.049 | 0.969 | |
| **English: Group Data** | | | | | |
| Group | Girls Mean | Boys Mean | Gender Gap | Overall Mean | Gender Ratio |
| Low Income | 10.137 | 9.812 | 0.325 | 9.974 | 1.033 |
| High Income | 10.631 | 10.315 | 0.316 | 10.473 | 1.031 |
| Low Education (PCG) | 10.223 | 9.899 | 0.324 | 10.061 | 1.033 |
| High Education (PCG) | 10.764 | 10.414 | 0.349 | 10.589 | 1.034 |
| Low Education (SCG) | 10.223 | 9.898 | 0.325 | 10.060 | 1.033 |
| High Education (SCG) | 10.794 | 10.434 | 0.360 | 10.614 | 1.035 |
| **English: Socioeconomic Effects** | | | | | |
| Income Effect | | | -0.009 | 0.499 | |
| PCG Education Effect | | | 0.025 | 0.528 | |
| SCG Education Effect | | | 0.035 | 0.553 | |

Table 1: Gender Achievement Gap in Maths and English by Socioeconomic Factors. This table presents mean Junior Certificate Maths and English scores for girls and boys across different income and parental education groups. Low-income levels are equivalent to the 1st, 2nd, and 3rd quintiles, while High-income accounts for the 4th and 5th quintiles. Parental education levels are separated by Low education (less than a Bachelor's degree) and High education (a Bachelor's degree or higher) for Primary caregiver (PCG) and Secondary Caregiver (SCG). It shows gender gaps (girls' mean minus boys' mean), overall mean scores, and gender ratios (girls' mean divided by boys' mean) for each group. Socioeconomic effects are calculated as the difference between high and low categories for each factor.

education levels correlate positively with better performance for both boys and girls. The socioeconomic effects reveal interesting patterns: a positive income effect (0.022) and primary caregiver education effect (0.014) suggest these factors help narrow the gender gap, while the negative secondary caregiver education effect (-0.049) indicates it widens the gap.

The relationship between parental education and the gender gap reveals notable patterns. While both household income and primary caregiver's education tend to narrow the achievement gap, secondary caregiver's education appears to have the opposite effect. Having a secondary caregiver with at least a bachelor's degree has a positive effect on both genders' Maths performance, with girls showing notable improvement, though not quite as substantial as boys. This leads to a wider gender gap in the high-education secondary caregiver group (-0.105) compared to the low-education group (-0.056), despite improved performance for both genders.

Throughout all socioeconomic groups, the gender ratios consistently remain slightly below 1 (ranging from 0.988 to 0.994), signaling a persistent advantage for boys in Maths performance regardless of socioeconomic status. The highest gender ratio appears in the low-education secondary caregiver group (0.994), indicating that the gender gap is smallest when the secondary caregiver has lower education levels. These patterns reveal the significance of intergenerational human capital transmission, with particularly intriguing differences in how maternal and paternal education relate to children's academic performance.

### 2. English Performance

In English, the socioeconomic patterns present a distinct picture from Maths. The most substantial gender gap emerges in groups where the secondary caregiver holds at least a Bachelor's degree (0.360), while the smallest gap appears in high-income groups (0.316). The socioeconomic effects further support this pattern: while the income effect is slightly negative (-0.009), suggesting higher income marginally reduces the gender gap, both primary and secondary caregiver education effects are positive (0.025 and 0.035 respectively), indicating that higher parental education levels tend to widen the gender gap in favor of girls.

The influence of parental education on English performance reveals particularly intriguing patterns. Higher education levels for both caregivers associate with larger gender gaps, not smaller ones - as shown by the gaps increasing from 0.324 to 0.349 for primary caregivers and from 0.325 to 0.360 for secondary caregivers with higher education. This finding suggests that girls might derive greater academic benefit from having educated caregivers when it comes to English performance, with the pattern being especially pronounced in households where both caregivers have higher education.

Across all socioeconomic groups, gender ratios consistently remain above 1 (ranging from 1.031 to 1.035), confirming girls' superior performance in English. This advantage persists regardless of household income or parental education levels, indicating that girls' stronger performance in English is a robust phenomenon that transcends socioeconomic boundaries. The gender ratio reaches its peak in the high-education secondary caregiver group (1.035), suggesting that while higher secondary caregiver education benefits both genders, it appears to disproportionately advantage girls in English performance.

## B. Gendered Patterns in Cognitive and Noncognitive Influences on Academic Performance

The following visualizations illustrate the associations between various cognitive and noncognitive factors and performance in Maths and English, with a particular focus on gender differences.

More can be found in the Appendix. Each figure uses a scatter plot to represent individual data points, with LOESS (locally weighted smoothing) lines overlaid to show general trends. The overall trend is represented by a black dashed line, while separate trends for boys (blue) and girls (red) are also displayed. While these visualizations effectively demonstrate the heterogeneity in relationships between variables, it is important to note they represent correlational, not causal, relationships.

In Maths, the relationship between cognitive ability and performance is notably non-linear, with boys showing advantages at both higher and lower cognitive ability levels. This pattern differs in English, where girls outperform boys across most cognitive ability levels, with the gender gap most pronounced in the middle range of cognitive abilities. The relationship appears more linear for boys than girls in English, though both groups show improved performance with higher cognitive ability.

Personality traits and behavioral factors demonstrate significant influence on academic outcomes. Conscientiousness positively correlates with performance in both subjects, with boys showing particularly strong benefits at higher levels. Similarly, attention control (measured inversely through Hyperactivity/Inattention scores) strongly predicts academic success, with boys' performance showing greater sensitivity to attention-related factors across both subjects.

Emotional factors display contrasting gender patterns. While girls generally score higher on most non-cognitive measures, boys show higher emotional stability scores. Boys' academic performance demonstrates greater sensitivity to emotional stability levels, while girls' performance appears more influenced by emotional symptoms. These emotional patterns persist across both Maths and English performance.

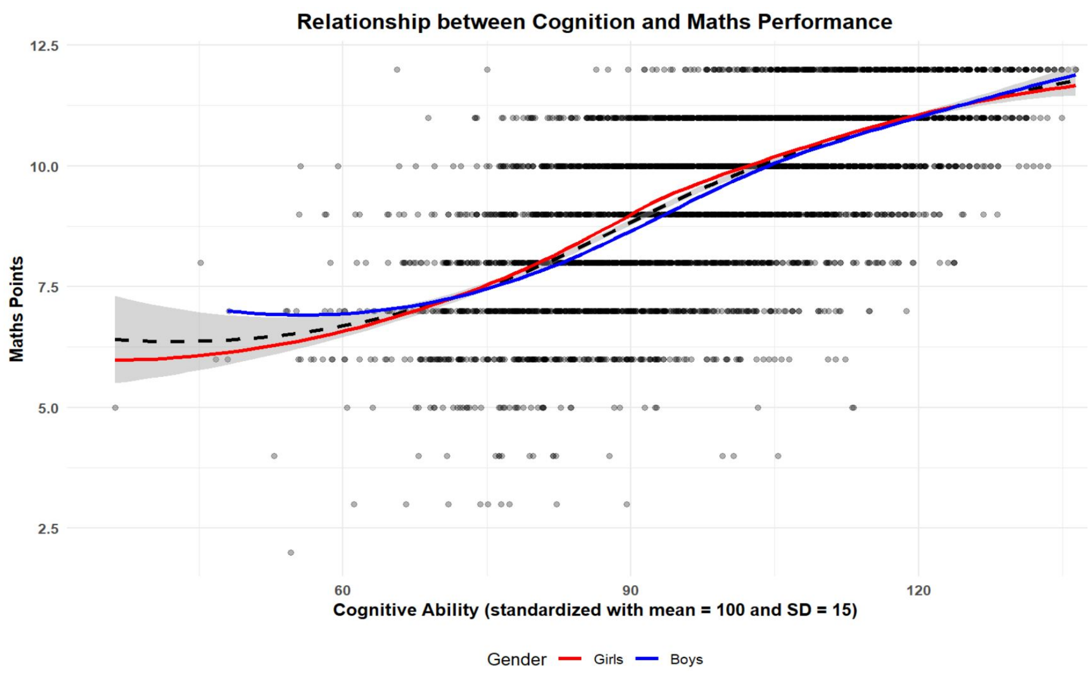


Figure 2: Cognitive Ability and Math Performance

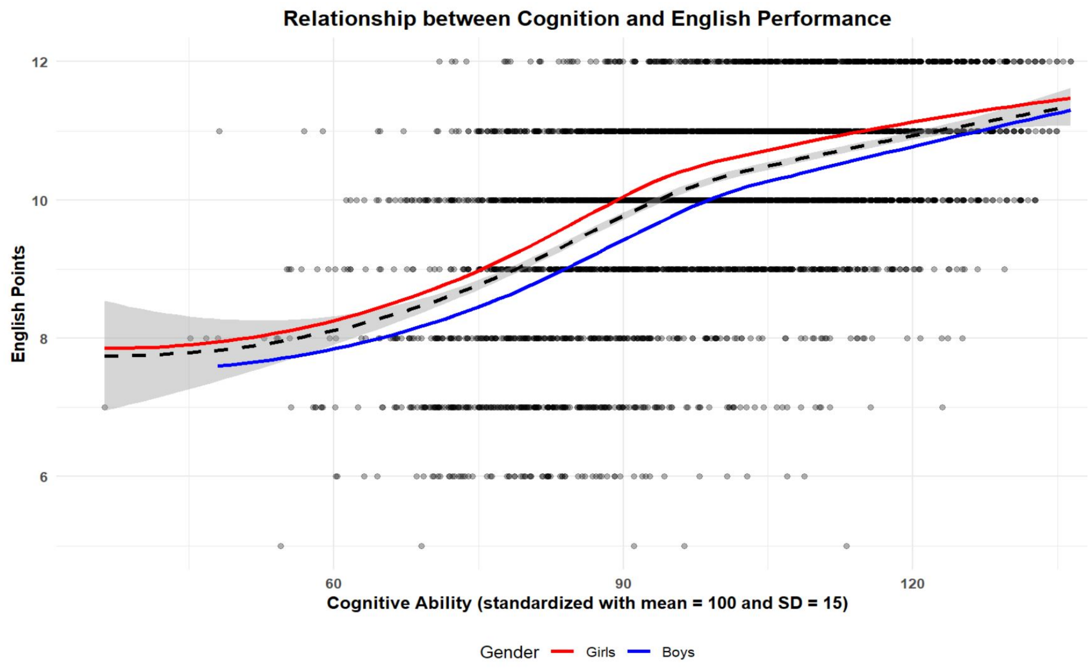


Figure 3: Cognitive Ability and English Performance

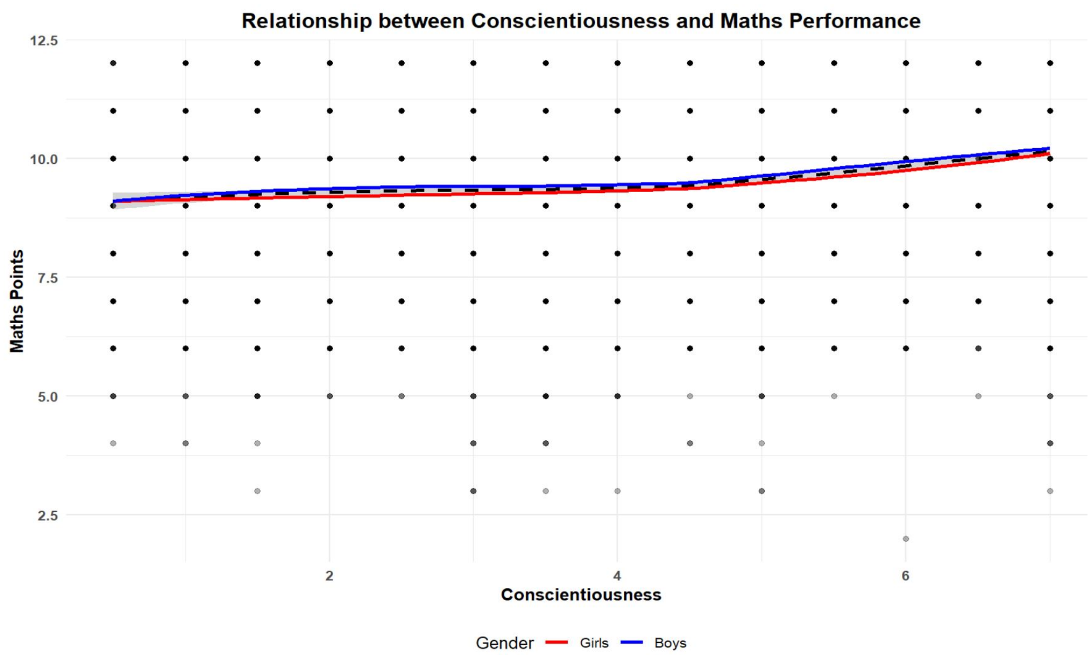


Figure 4: Conscientiousness and Math Performance

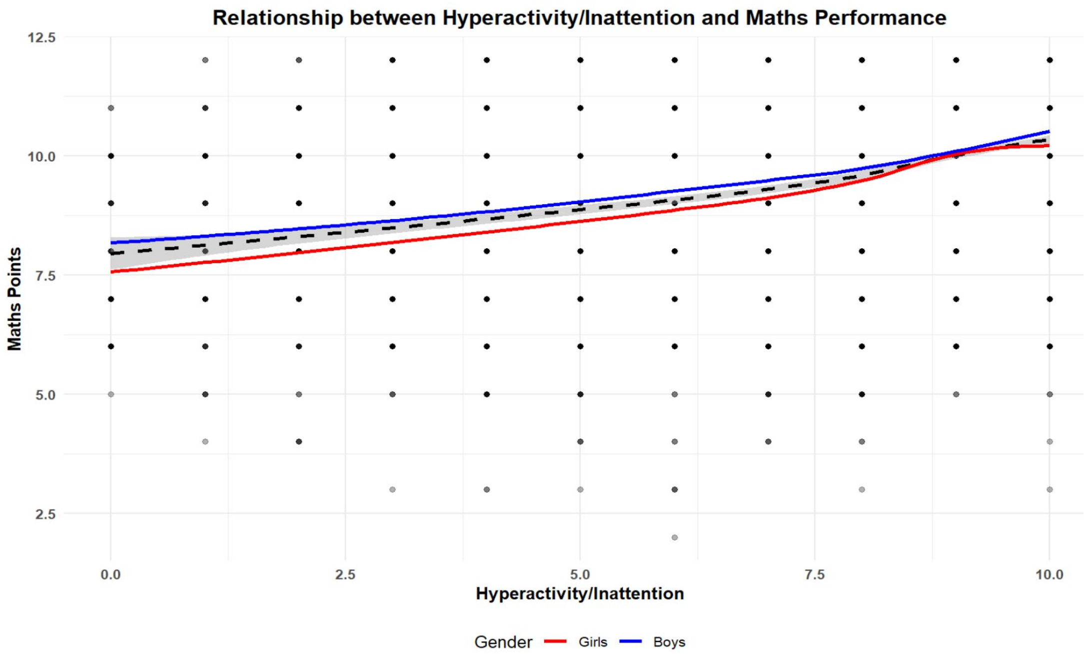


Figure 5: Hyperactivity/Inattention and Math Performance

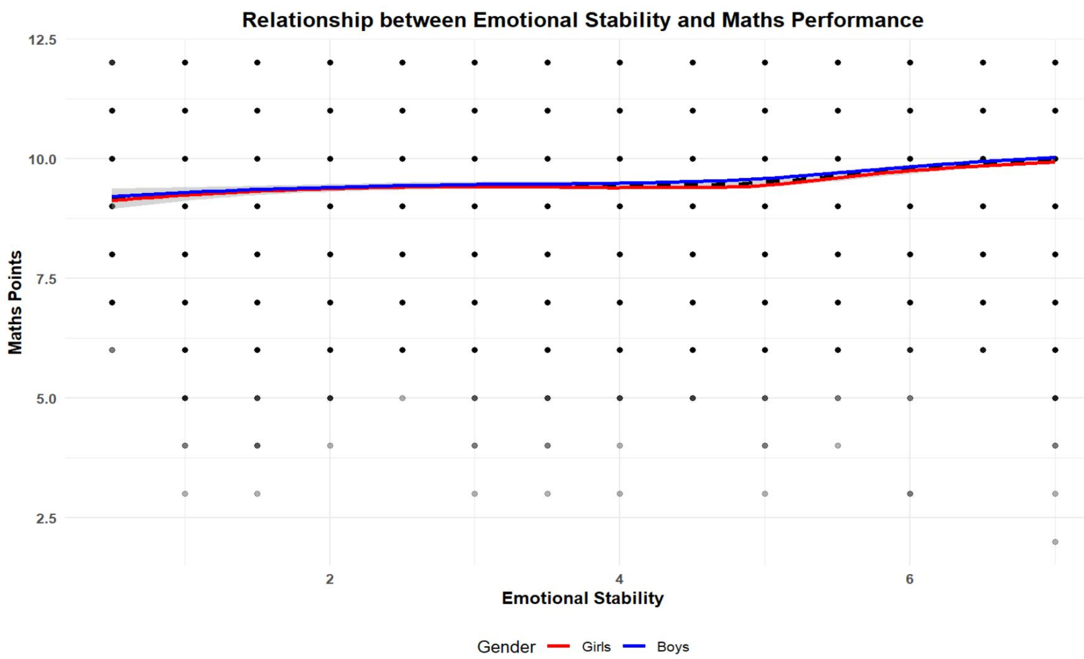


Figure 6: Emotional Stability and Math Performance

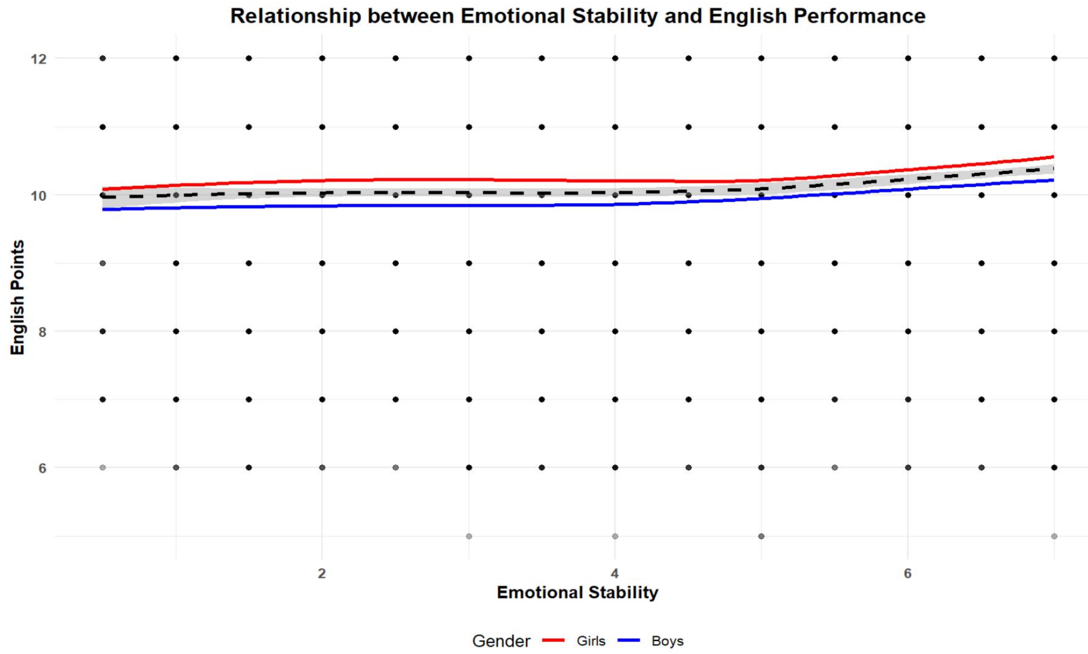


Figure 7: Emotional Stability and English Performance

# V. Discussion

The findings from this analysis have implications for our understanding of human capital formation and the economics of education. The persistent gender gaps in academic performance, particularly the male underperformance in English and female underperformance in Maths suggest potential inefficiencies in human capital accumulation. These gaps may lead to suboptimal educational and career choices, potentially affecting labor market outcomes and overall economic productivity (Altonji & Blank, 1999).

The strong influence of cognitive factors on academic performance further emphasizes the importance of early skill formation, as championed by Heckman (2006). The differences in returns to cognitive and noncognitive skills between genders suggest that there might be gender-specific patterns in the production function of human capital, which could have implications for understanding wage differentials and occupational segregation later in the labor market (Blau & Kahn, 2017).

Also the finding that socioeconomic and school-related factors mediate some of the gender differences in cognitive skills highlights the role of family background and educational inputs in shaping academic outcomes. This aligns with the literature on intergenerational transmission of human capital and the production function of cognitive and noncognitive skills (Cunha & Heckman, 2007).

The varying gender gaps across different income and education levels suggest that the relationship between socioeconomic status and academic achievement is complex and potentially non-linear. This finding contributes to the ongoing debate about the relative importance of nature versus nurture in determining educational outcomes (Sacerdote, 2011).

The gender gaps in academic performance observed may have significant long-term economic consequences, particularly in terms of occupational segregation and wage differentials in the labor market. The underperformance of boys in English and girls in Maths could potentially lead to gender-based sorting into different educational tracks and, subsequently, into different occupations. This aligns with the theory of comparative advantage in occupational choice

(Rosen, 1978), where individuals select occupations based on their relative strengths.

As an example, the superior performance of girls in English might lead to their overrepresentation in humanities and social sciences, while boys' better performance in Maths could result in their dominance in STEM fields. This occupational segregation does have substantial implications for the labor market and the economy as a whole. Blau and Kahn (2017) argue that occupational segregation is a major contributor to the gender wage gap, as female-dominated occupations often pay less than male-dominated ones, even when controlling for skill levels and job characteristics.

Also, if these academic performance gaps persist into adulthood, they could contribute to skill differentials between men and women in the labor force. Given the increasing importance of both quantitative and communication skills in the modern economy (Deming, 2017), gender-based skill gaps would then lead to inefficient allocation of talent and reduced overall productivity.

My findings also relate to theories of statistical discrimination in labor markets (Phelps, 1972). If employers believe that these gender differences in academic performance reflect underlying differences in skills or abilities, they might use gender as a proxy for productivity in hiring and promotion decisions. For example, an employer might be more inclined to hire a man for a Maths-intensive job based on the average performance gap, even if the specific woman applicant is equally or more qualified, which then triggers a snowball effect, that could lead to a self-fulfilling prophecy where women, anticipating discrimination, invest less in Maths skills, thus perpetuating the gap.

I have to note that these potential long-term consequences are speculative and based on the assumption that early academic performance gaps persist and translate into labor market outcomes. Longitudinal studies tracking individuals from school to the labor market would be necessary to confirm these hypotheses.

There are a few attempts to explain the observed patterns in gender achievement gaps across socioeconomic groups. Being in a higher-income household may contribute to narrowing the gap through some channels: higher incomes most likely result in increased access to educational resources, it might reduce stress due to economic stability, and also create the possibility of greater parental involvement in children's education (Sirin, 2005). For example, Davis-Kean (2005) found that, on average, highly educated parents value education more highly, which then creates a more stimulating home environment while making them better equipped to assist with homework. The recurrent gender gaps across all levels point to the possibility of more or less ingrained societal expectations about gender roles in academic subjects. These gaps may also reflect differences in teaching methods, brain development patterns, or gender-specific interests and engagement levels (Ceci et al., 2009). Other interesting factors identified in the literature include stereotype threat, where awareness of negative stereotypes can impair performance (Spencer et al., 1999); differences in spatial skills development (Levine et al., 2005); and the influence of same-gender teachers as role models (Beilock et al., 2010). Huang (2013) showed that gender differences in self-efficacy and academic self-concept, particularly in STEM fields, have also been shown to contribute to achievement gaps. In addition, cross-cultural studies suggest that societal gender equality is associated with reduced gender gaps in Maths achievement (Guiso et al., 2008). The relative absence of women in STEM fields may also perpetuate these gaps through a lack of visible role models (Blickenstaff, 2005).

In terms of cognitive and noncognitive measures, boys score higher than girls, on average, in all cognitive measures in all waves, even when subsetting by parents' income and education levels. Girls only outperform boys in Junior Cert English scores. Boys also have higher means than girls in all control variables (SES status and school characteristics), even if there are fewer of them represented in the sample. Conversely, girls outperform boys in all noncognitive indicators except for Emotional Stability (Neuroticism) and Emotional Resilience.

These results ask for a deeper analysis, so I employed the Oaxaca-Blinder decomposition (Blinder, 1973; Oaxaca, 1973), or Kitagawa decomposition (Kitagawa, 1955), method to see from where exactly these differences in grades (girls score higher than boys in English, and boys score higher than girls in Maths) arise, if from the cognitive part of the model or the noncognitive one, and how much these differences matter to the final outcome (Junior Cert grades).

# VI. Oaxaca-Blinder Decomposition

The Oaxaca-Blinder decomposition is a statistical method used to explain the differences in the means of an outcome variable between two groups. In my study, I used it to analyze the gender achievement gap in academic performance. This technique was independently developed by Ronald Oaxaca (1973) and Alan Blinder (1973), and has since become a standard tool in labour economics and other social sciences. The decomposition divides the difference in outcomes between two groups into the ”explained” and the ”unexplained” part. The former portion of the difference is attributed to group differences in measurable characteristics or predictors (e.g., cognitive abilities, noncognitive skills), and the latter is the residual portion that cannot be accounted for by the observed characteristics. The ”unexplained” part is often interpreted as a measure of discrimination or the effect of unobserved variables.

In the context of my study, the Oaxaca-Blinder decomposition allows me to quantify how much of the gender achievement gap in Maths and English could be attributed to differences in cognitive and noncognitive skills between boys and girls, and how much remained unexplained by these factors.

This method has been widely used in educational research. For example, Fortin et al. (2015) used it to decompose gender differences in academic achievement across several countries, while Niederle and Vesterlund (2010) applied this technique to analyze gender gaps in Maths performance.

The Oaxaca-Blinder decomposition has its flaws and caution in the interpretation of results is advised. As pointed out by Jones and Kelley (1984), the choice of reference group can affect the results, and the unexplained portion should be carefully interpreted.

In the Oaxaca-Blinder decomposition, Female is Group 1 (= 0) and Male is Group 2 (= 1), so whenever we have a negative result in group differences (first panel of the tables), it means that the value from Group 2 is bigger than for Group 1, and the opposite holds. When we get a negative coefficient for the variables considered, it means that the variable is associated with mitigating or reducing the difference in outcomes between the two groups, in our case the variable contributes to reducing the gender achievement gap, and the opposite also holds (a positive coefficient contributes to increasing the gender achievement gap). The magnitude of the coefficients indicates how much they contribute to the size of the Endowments, Coefficients, and Interaction for the three-fold decomposition, and Explained and Unexplained parts of the two-fold decomposition. Both SDQ and TIPI as indicators of noncognition yield similar results when analyzing each subject (Maths and English).

## A. Results

Cognitive factors emerge as significant contributors to narrowing the gender achievement gap. Among these, Numerical ability and Vocal Reasoning stand out as the strongest contributors to explained differences. However, certain non-cognitive factors, particularly Hyperactivity/Inattention and Conscientiousness, work in the opposite direction, tending to widen the gap. The

Table 2: Descriptive Statistics by Gender with Mean Differences

| Variable | Female Mean | Female SD | Male Mean | Male SD | Mean Difference (F-M) |
|---|---|---|---|---|---|
| Maths_points | 9.55 | 1.75 | 9.65 | 1.72 | -0.10 |
| English_points | 10.31 | 1.30 | 9.98 | 1.35 | 0.33 |
| PC1 | 5.63 | 1.36 | 5.94 | 1.34 | -0.31 |
| Drum_VR_W2_p | 62.86 | 22.76 | 67.17 | 20.74 | -4.31 |
| Drum_NA_W2_p | 51.89 | 21.84 | 58.43 | 22.69 | -6.54 |
| BAS_TS_Mat_W2 | 116.57 | 17.91 | 117.19 | 17.74 | -0.62 |
| SDQ_emot_PCG_W2 | 8.10 | 1.93 | 8.50 | 1.78 | -0.40 |
| SDQ_cond_PCG_W2 | 8.99 | 1.26 | 8.95 | 1.35 | 0.04 |
| SDQ_hyper_PCG_W2 | 7.89 | 2.08 | 7.23 | 2.40 | 0.66 |
| SDQ_peer_PCG_W2 | 9.02 | 1.35 | 8.90 | 1.47 | 0.12 |
| Agreeable_W2_PCG | 5.14 | 1.93 | 4.88 | 1.96 | 0.26 |
| Conscientious_W2_PCG | 4.48 | 2.07 | 4.17 | 2.06 | 0.31 |
| Emo_Stability_W2_PCG | 4.35 | 2.00 | 4.45 | 1.98 | -0.10 |
| Extravert_W2_PCG | 4.01 | 2.00 | 3.96 | 1.96 | 0.05 |
| Openness_W2_PCG | 4.83 | 1.80 | 4.64 | 1.85 | 0.19 |
| PCG_Educ_W2 | 3.91 | 1.23 | 4.02 | 1.24 | -0.11 |
| SCG_Educ_W2 | 3.80 | 1.35 | 3.90 | 1.37 | -0.10 |
| Income_equi_quint | 3.31 | 1.39 | 3.35 | 1.40 | -0.04 |
| DEIS_binary_W2 | 0.12 | 0.32 | 0.13 | 0.33 | -0.01 |
| Fee_paying_W2 | 0.08 | 0.28 | 0.12 | 0.32 | -0.04 |
| Mixed | 0.52 | 0.50 | 0.57 | 0.50 | -0.05 |

magnitude of these explained differences appears notably larger in Maths, almost twice the size observed in English.

The analysis reveals a larger unexplained portion in English compared to Maths. Conduct problems emerge as the primary contributor to these unexplained differences. Higher levels of Numerical ability associate with decreased gender achievement gaps, though this relationship varies significantly across cognitive ability levels.

1) **Threefold decomposition**:

1.1 **Endowments** (observed covariates): For Maths, cognitive Endowments for SDQ and TIPI (Tables 3 and 5) are always more significant and bigger in magnitude (in module) than Endowments for noncognitive indicators, and both are similar in absolute numbers, directions, and significance when comparing them within each subject. Endowments for cognitive indicators are bigger in absolute numbers when considering the TIPI noncognitive indicators than when we use the SDQ noncognitive ones for both Maths and English (with the difference in Maths being bigger than English). Since Vocal reasoning and Numerical ability are on the same scale, they are directly comparable, and we see that for Maths the Endowment for Numerical ability is more than three times the Endowment for Vocal reasoning, a result that does not hold for English (Tables 4 and 6), where the Endowments for these two variables are almost equal. In terms of noncognitive indicators' significance, only the Endowments for Hyperactivity/Inattention (SDQ) and Conscientiousness (TIPI) are significant for Maths and English. All significant Endowments for noncognitive indicators either stay the same or increase in absolute magnitude as more controls are added, whereas the Endowments for cognition, when significant, all decrease in magnitude as more controls are added. The inclusion of SES and school controls (columns II-IV in each table) generally reduces the magnitude of the explained portion of the gap, particularly for cognitive variables. This implies that some of the gender differences in cognitive skills are mediated by socioeconomic and school-related factors. Endowments for cognitive variables are all negative for Maths and English when considering both SDQ and TIPI noncognitive indicators. Endowments for noncognitive indicators are positive when significant at the 99% and 95% CIs (Conscientiousness and Hyperactivity/Inattention) for both subjects when broken down into variables, and negative and highly significant when considered in total.

1.2. **Coefficients** (returns to Endowments): The Coefficients, when accounted for in total, are not significant for Maths with SDQ noncognitive indicators (3), but highly significant and positive for Maths and English with TIPI noncognitive indicators (Tables 5 and 6), and English with SDQ noncognitive indicators (Table 4). The Coefficients for English are almost four times bigger in magnitude than the Coefficients for Maths. When accounted for individually, only the Coefficient for Conduct problems (Maths SDQ, noncognition) is significant at the 90% CI, and it increases positively in magnitude as more controls are added.

1.3. **Interaction**: The interaction term accounts for the fact that differences in Endowments and Coefficients exist simultaneously between Groups 1 and 2 (Jann, 2008). None of the interaction terms are significant when accounted for individually and in total, and they are positive and very small in magnitude when not equal to zero.

2) **Twofold decomposition**:

2.1. **Explained**: The composition (explained) effect is the difference in grades due to differences in the Endowments of the individuals across the two groups (Popli, 2013). Results are similar within subjects and across SDQ and TIPI decompositions. For both Maths and English, the Explained parts, when accounted for in total, are always highly significant and negative, and the magnitude for Maths is almost twice the magnitude for English for both SDQ (-0.225 versus -0.105) and TIPI (-0.268 versus -0.147) in absolute terms, with the results within subjects across noncognitive scales being always higher when considering the TIPI than the SDQ scale. In terms of cognitive variables, Vocal reasoning and Numerical ability are always negative and highly significant for both subjects across the two noncognitive scales, with Numerical ability being three times bigger in absolute terms than Vocal reasoning for Maths and similar in magnitude for English also across noncognitive scales. Matrices is negative but only slightly significant for Maths, and only one-fourth in absolute magnitude to Vocal reasoning. All cognitive variables decrease in absolute magnitude as more controls are added. When analyzing the noncognitive variables, we see that only two are positive and highly significant - SDQ Hyperactivity/Inattention and TIPI Conscientiousness for both Maths and English - and one is slightly significant (at the 90% CI) and negative - SDQ Emotional symptoms for Maths. All noncognitive significant variables either increase in magnitude or stay the same more controls are added.

2.2. **Unexplained**: The unexplained component (residual) is here defined as the achievement gap associated with some sort of discrimination (probably unintended), unobserved heterogeneity, and omitted (not on purpose) variables (akin to (Popli, 2013)), and is the difference in mean grades due to the difference in returns to individual characteristics (the Coefficients of the threefold decomposition). Results are similar within subjects and across SDQ and TIPI decompositions for the Unexplained parts as well. For both Maths and English, the Unexplained parts, when accounted for in total, are always highly significant (except for Maths SDQ with all controls) and positive, with the magnitudes for English being more than four times the magnitudes for Maths for both SDQ (0.416 versus 0.107) and TIPI (0.457 versus 0.150), and the results within subjects across noncognitive scales are always higher when considering the TIPI than the SDQ scale. In terms of cognitive variables, none is significant individually. The only noncognitive variable that is positive and highly significant is Conduct problems (for Maths SDQ), and it increases in magnitude as more controls are added.

Maybe the most interesting part of the decomposition is the unexplained part of the two-fold one. It pertains to the residual differences in unmeasured skills or attributes, or discrimination if we are talking about wages or non-blind grading, and it tells about the portion of the gender achievement gap that cannot be explained by differences in observable characteristics. The highest coefficient in magnitude is Conduct problems (equal to 0.708, Table 7), but it is only slightly significant (at the 90% CI). Its sign indicates that having more conduct problems is associated with a larger gap in Maths scores between the two groups, and its magnitude indicates that it is the greatest contributor to the unexplained part in Table 7. Conduct problems is also the greatest positive contributor to unexplained parts in English scores (Table 8). Higher levels of Numerical ability are always associated with a decrease in the gender achievement gap, although it is not independently significant. The signs of other cognitive variables vary, as do their magnitude in terms of contribution to the Unexplained parts.

The Explained part of the Oaxaca-Blinder decomposition tells us how much of the gender achievement gap can be attributed to differences in observable characteristics (represented by the explanatory variables) between boys and girls. Complementary to the results presented in the regression tables, the negative signs of all the cognitive coefficients indicate that the bigger they are, the more they contribute to closing the gender achievement gap, with Numerical ability and Vocal Reasoning being always highly significant and also the greatest contributors, in magnitude, to the Explained parts, regardless of what explanatory variables we consider. Some noncognitive coefficients such as Hyperactivity/Inattention, and Conscientiousness are also highly significant, but positive in sign, which indicates that they contribute to increasing the gender achievement gap for both Maths and English scores. On average, then, having higher values of Hyperactivity/Inattention, and Conscientiousness is associated with a larger achievement gap between boys and girls. Among the noncognitive skills, Hyperactivity/Inattention (in SDQ) and Conscientiousness (in TIPI) always emerge as important factors. Interestingly, these variables often work in the opposite direction of cognitive skills, widening rather than narrowing the gender achievement gap. This emphasizes the complex nature of gender differences in academic achievement and suggests that improving certain noncognitive skills might have unintended consequences on gender equity in education.

While the Oaxaca-Blinder decomposition provides informative insights, it is important to note its limitations. The method assumes that the relationships between variables are linear and additive, which may not fully capture the complexity of educational processes. Additionally, the unexplained portion of the gap could be due to unmeasured factors or non-linear relationships not captured by the proposed model.

I also conducted a granular analysis where I separated boys and girls by the household-income and caregivers' educational level. I found that a) the gender gap in Maths (favouring boys) tends to be smaller in higher-income and higher-education households; b) The gender gap in English (favouring girls) tends to be larger in higher-education households; c) The "Endowments" effect (which is the explained portion of the gap) tends to be larger for lower-income and lower-education households, especially in Maths. The gender achievement gap is very consistent: in Maths, boys always score slightly higher than girls across all income and education levels. In English, girls always score higher than males across all categories. Higher-income and higher primary caregiver (usually the mother) education levels are associated with higher scores in both subjects for both genders. For Maths, the Endowments component is always negative, suggesting that differences in characteristics favor boys. For English, the Coefficients component is always positive and larger, indicating that girls have an advantage in how their characteristics translate into test scores. The gender gaps and decomposition results vary somewhat by income level and caregiver education, but the overall patterns remain consistent: higher income and education levels are associated with smaller gender gaps in Maths and slightly larger gaps in English favouring girls.

# VII. Educational Policy Implications

Effective interventions should account for gender differences in both cognitive and non-cognitive skill development. Particular attention should focus on attention control strategies for boys and emotional support programs tailored to gender-specific needs. The distinctive role of both cognitive and noncognitive factors suggests the need for multifaceted educational interventions. For example, while programs to enhance numerical ability could help narrow the gap in Maths, targeted interventions to address Hyperactivity/Inattention, particularly among boys, might yield benefits across subjects.

Additionally, efforts to cultivate conscientiousness in all students, while being mindful of its potential to widen gender gaps, could enhance overall academic performance.

The persistent gender gaps in academic performance, particularly male underperformance in English and female underperformance in Maths, may be diminished through proper and targeted interventions within the education system.

Given the strong influence of cognitive factors, policies could focus on enhancing subject-specific cognitive skills from an early age. For example, initiatives to boost numerical reasoning among girls and verbal skills among boys could be integrated into primary school curricula. Socioeconomic factors require careful consideration in policy design. Educational programs should address inequalities through targeted funding, account for parental education levels, and develop specific strategies for narrowing gaps in lower-income households. The finding that socioeconomic and school-related factors mediate some of the gender differences in cognitive skills emphasizes the importance of addressing these educational inequalities. Policies aimed at reducing socioeconomic disparities in education, such as targeted funding for disadvantaged schools or expanded early childhood education programs, could indirectly help narrow gender achievement gaps.

# VIII. Conclusion

My research demonstrates that the gender achievement gap is a complex phenomenon influenced by multiple factors, such as, but not constrained to, cognitive abilities, non-cognitive traits, and socioeconomic factors. While cognitive abilities play a fundamental role, non-cognitive factors and socioeconomic conditions significantly shape these differences. This suggests the need for a comprehensive approach to education that considers cognitive abilities, personality traits, and socioeconomic factors while acknowledging gender-specific patterns in academic achievement.

Several key findings emerge from the results. First, the persistence of gender-specific patterns across subjects — boys' advantage in Maths and girls' superiority in English — suggests deeply rooted differences in academic achievement that transcend socioeconomic boundaries. However, these gaps are not homogeneous; they vary significantly with household income and parental education levels, which highlights the role of socioeconomic factors in mediating gender differences in academic performance.

Second, the Oaxaca-Blinder decomposition reveals that cognitive abilities, particularly numerical and verbal reasoning, are fundamental in explaining these gaps. It emerges from it that cognitive factors tend to narrow gender achievement gaps, while certain non-cognitive traits like Hyperactivity/Inattention and Conscientiousness often work in the opposite direction, widening these gaps. This finding suggests that cognitive and non-cognitive skills operate through distinct channels in influencing academic performance.

Third, there are important asymmetries in how boys and girls respond to various factors. Boys' academic performance shows greater sensitivity to attention-related factors and emotional stability, while girls' performance appears more influenced by emotional symptoms, and these gender-specific patterns are consistent across both Maths and English performance, indicating robust underlying differences in how various traits and abilities translate into academic achievement.

These findings have significant implications for educational policy and practice. They suggest that interventions aimed at reducing gender gaps should adopt a multifaceted approach, addressing both cognitive skill development and non-cognitive trait enhancement; educational strategies should be tailored to account for gender-specific sensitivities to different factors; socioeconomic interventions, particularly those targeting parental education and household resources, could have substantial indirect effects on gender achievement gaps

The research also points to several promising directions for future investigation. Further studies might explore the long-term implications of these achievement gaps for career choices and labor market outcomes, the effectiveness of targeted interventions designed to address gender-specific patterns in skill development, the role of school-level factors and teaching methods in either mitigating or exacerbating these gaps, and the interaction between gender-specific patterns and evolving educational technologies.

It is important to understand these gender achievement gaps not only for their specific implications for educational policy but also for broader social and economic outcomes. As the modern economy increasingly demands both strong quantitative and communication skills, addressing these gender-specific patterns in academic achievement becomes essential for ensuring efficient human capital development and reducing future labor market inequalities.

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# IX. Appendix

## A. Oaxaca-Blinder Decomposition

### 1. SDQ Results - Threefold decomposition

Table 3: **Maths SDQ** Results - Threefold decomposition

| | **Maths Points** | | | |
|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** |
| Female (Group 1) | 9.685*** | 9.685*** | 9.685*** | 9.685*** |
| Male (Group 2) | 9.803*** | 9.803*** | 9.803*** | 9.803*** |
| Difference | -0.118* | -0.118* | -0.118* | -0.118* |
| Endowments | -0.264*** | -0.255*** | -0.247*** | -0.244*** |
| Coefficients | 0.101* | 0.096* | 0.083 | 0.082 |
| Interaction | 0.045 | 0.041 | 0.046 | 0.044 |
| **Endowments** | | | | |
| Vocal reasoning | -0.071*** | -0.057*** | -0.064*** | -0.055*** |
| Numerical ability | -0.210*** | -0.192*** | -0.200*** | -0.187*** |
| Matrices | -0.014* | -0.014* | -0.015* | -0.015* |
| Emotional symptoms | -0.019* | -0.016* | -0.017* | -0.015 |
| Conduct problems | 0.001 | 0.001 | 0.001 | 0.001 |
| Hyperactivity/Inattention | 0.049*** | 0.050*** | 0.051*** | 0.051*** |
| Peer-relationship problems | 0.001 | 0.000 | 0.000 | 0.000 |
| **Coefficients** | | | | |
| Vocal reasoning | 0.016 | -0.023 | 0.037 | -0.010 |
| Numerical ability | -0.235 | -0.155 | -0.153 | -0.115 |
| Matrices | 0.268 | 0.115 | 0.128 | 0.045 |
| Emotional symptoms | -0.043 | -0.129 | -0.030 | -0.109 |
| Conduct problems | 0.561 | 0.662* | 0.664* | 0.706* |
| Hyperactivity/Inattention | 0.221 | 0.199 | 0.213 | 0.191 |
| Peer-relationship problems | -0.119 | -0.099 | -0.158 | -0.117 |
| Constant | -0.567 | -0.570 | -0.519 | -0.549 |
| **Interaction** | | | | |
| Vocal reasoning | -0.001 | 0.001 | -0.002 | 0.001 |
| Numerical ability | 0.027 | 0.018 | 0.018 | 0.013 |
| Matrices | -0.003 | -0.001 | -0.001 | -0.000 |
| Emotional symptoms | 0.002 | 0.007 | 0.002 | 0.006 |
| Conduct problems | 0.002 | 0.003 | 0.003 | 0.003 |
| Hyperactivity/Inattention | 0.018 | 0.017 | 0.018 | 0.016 |
| Peer-relationship problems | -0.001 | -0.001 | -0.002 | -0.001 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

Table 4: **English SDQ** Results - Threefold decomposition

| | **English Points** | | | |
|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** |
| Female (Group 1) | 10.402*** | 10.402*** | 10.402*** | 10.402*** |
| Male (Group 2) | 10.091*** | 10.091*** | 10.091*** | 10.091*** |
| Difference | 0.310*** | 0.310*** | 0.310*** | 0.310*** |
| Endowments | -0.123*** | -0.123*** | -0.107*** | -0.104*** |
| Coefficients | 0.427*** | 0.427*** | 0.420*** | 0.419*** |
| Interaction | 0.007 | 0.007 | -0.002 | -0.005 |
| **Endowments** | | | | |
| Vocal reasoning | -0.085*** | -0.085*** | -0.082*** | -0.079*** |
| Numerical ability | -0.085*** | -0.085*** | -0.079*** | -0.074*** |
| Matrices | -0.003 | -0.003 | -0.004 | -0.003 |
| Emotional symptoms | -0.004 | -0.004 | -0.003 | -0.002 |
| Conduct problems | -0.000 | -0.000 | -0.001 | -0.001 |
| Hyperactivity/Inattention | 0.050*** | 0.050*** | 0.051*** | 0.052*** |
| Peer-relationship problems | 0.005 | 0.005 | 0.005 | 0.005 |
| **Coefficients** | | | | |
| Vocal reasoning | -0.114 | -0.114 | -0.100 | -0.142 |
| Numerical ability | -0.066 | -0.066 | -0.029 | -0.022 |
| Matrices | 0.070 | 0.070 | 0.022 | -0.013 |
| Emotional symptoms | 0.006 | 0.006 | 0.014 | -0.024 |
| Conduct problems | 0.076 | 0.076 | 0.156 | 0.176 |
| Hyperactivity/Inattention | -0.084 | -0.084 | -0.099 | -0.113 |
| Peer-relationship problems | 0.038 | 0.038 | 0.012 | 0.035 |
| Constant | 0.501 | 0.501 | 0.399 | 0.295 |
| **Interaction** | | | | |
| Vocal reasoning | 0.006 | 0.006 | 0.006 | 0.008 |
| Numerical ability | 0.008 | 0.008 | 0.003 | 0.003 |
| Matrices | -0.001 | -0.001 | -0.000 | 0.000 |
| Emotional symptoms | -0.000 | -0.000 | -0.001 | 0.001 |
| Conduct problems | 0.000 | 0.000 | 0.001 | 0.001 |
| Hyperactivity/Inattention | -0.007 | -0.007 | -0.008 | -0.009 |
| Peer-relationship problems | 0.000 | 0.000 | 0.000 | 0.000 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

## 2. TIPI Results - Threefold decomposition

Table 5: **Maths TIPI** Results - Threefold decomposition

| | **Maths Points** | | | |
|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** |
| Female (Group 1) | 9.685*** | 9.685*** | 9.685*** | 9.685*** |
| Male (Group 2) | 9.803*** | 9.803*** | 9.803*** | 9.803*** |
| Difference | -0.118* | -0.118* | -0.118* | -0.118* |
| Endowments | -0.302*** | -0.289*** | -0.284*** | -0.279*** |
| Coefficients | 0.157*** | 0.154*** | 0.139** | 0.139*** |
| Interaction | 0.027 | 0.017 | 0.027 | 0.022 |
| **Endowments** | | | | |
| Vocal reasoning | -0.076*** | -0.062*** | -0.070*** | -0.060*** |
| Numerical ability | -0.221*** | -0.201*** | -0.210*** | -0.196*** |
| Matrices | -0.015* | -0.015* | -0.015* | -0.015* |
| Agreeableness | 0.003 | 0.003 | 0.003 | 0.003 |
| Conscientiousness | 0.015* | 0.018** | 0.016** | 0.018** |
| Emotional stability | -0.004 | -0.003 | -0.004 | -0.003 |
| Extraversion | -0.001 | -0.001 | -0.001 | -0.001 |
| Openness | -0.003 | -0.001 | -0.002 | -0.000 |
| **Coefficients** | | | | |
| Vocal reasoning | 0.042 | -0.002 | 0.070 | 0.014 |
| Numerical ability | -0.216 | -0.136 | -0.132 | -0.096 |
| Matrices | 0.305 | 0.156 | 0.178 | 0.091 |
| Agreeableness | -0.029 | 0.027 | -0.021 | 0.026 |
| Conscientiousness | 0.130 | 0.072 | 0.116 | 0.068 |
| Emotional stability | -0.018 | 0.007 | 0.000 | 0.015 |
| Extraversion | -0.012 | 0.010 | -0.012 | 0.009 |
| Openness | -0.051 | -0.056 | -0.072 | -0.066 |
| Constant | 0.006 | -0.014 | 0.116 | 0.033 |
| **Interaction** | | | | |
| Vocal reasoning | -0.002 | 0.000 | -0.004 | -0.001 |
| Numerical ability | 0.025 | 0.016 | 0.015 | 0.011 |
| Matrices | -0.003 | -0.002 | -0.002 | -0.001 |
| Agreeableness | -0.002 | 0.001 | -0.001 | 0.001 |
| Conscientiousness | 0.011 | 0.006 | 0.010 | 0.006 |
| Emotional stability | 0.001 | -0.000 | -0.000 | -0.000 |
| Extraversion | -0.000 | 0.000 | -0.000 | 0.000 |
| Openness | -0.002 | -0.002 | -0.003 | -0.003 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

## 3. SDQ Results - Twofold decomposition

Table 6: **English TIPI** Results - Threefold decomposition

| | English Points | | | |
|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** |
| Female (Group 1) | 10.402*** | 10.402*** | 10.402*** | 10.402*** |
| Male (Group 2) | 10.091*** | 10.091*** | 10.091*** | 10.091*** |
| Difference | 0.310*** | 0.310*** | 0.310*** | 0.310*** |
| Endowments | -0.170*** | -0.163*** | -0.154*** | -0.150*** |
| Coefficients | 0.462*** | 0.461*** | 0.454*** | 0.454*** |
| Interaction | 0.018 | 0.012 | 0.010 | 0.006 |
| **Endowments** | | | | |
| Vocal reasoning | -0.089*** | -0.083*** | -0.086*** | -0.082*** |
| Numerical ability | -0.095*** | -0.087*** | -0.088*** | -0.083*** |
| Matrices | -0.004 | -0.003 | -0.004 | -0.004 |
| Agreeableness | 0.006 | 0.006 | 0.007 | 0.007 |
| Conscientiousness | 0.012* | 0.013** | 0.013* | 0.014** |
| Emotional stability | -0.001 | -0.000 | -0.001 | -0.000 |
| Extraversion | 0.000 | 0.000 | 0.000 | 0.000 |
| Openness | -0.000 | 0.001 | 0.001 | 0.002 |
| **Coefficients** | | | | |
| Vocal reasoning | -0.114 | -0.157 | -0.097 | -0.145 |
| Numerical ability | -0.104 | -0.077 | -0.066 | -0.060 |
| Matrices | 0.060 | -0.006 | 0.020 | -0.017 |
| Agreeableness | -0.094 | -0.062 | -0.082 | -0.054 |
| Conscientiousness | 0.035 | 0.009 | 0.028 | 0.006 |
| Emotional stability | -0.024 | -0.012 | -0.022 | -0.015 |
| Extraversion | 0.018 | 0.027 | 0.021 | 0.030 |
| Openness | 0.025 | 0.020 | 0.006 | 0.006 |
| Constant | 0.660* | 0.583* | 0.605* | 0.477 |
| **Interaction** | | | | |
| Vocal reasoning | 0.007 | 0.009 | 0.006 | 0.008 |
| Numerical ability | 0.012 | 0.009 | 0.008 | 0.007 |
| Matrices | -0.001 | 0.000 | -0.000 | 0.000 |
| Agreeableness | -0.005 | -0.003 | -0.004 | -0.003 |
| Conscientiousness | 0.003 | 0.001 | 0.002 | 0.001 |
| Emotional stability | 0.001 | 0.000 | 0.001 | 0.000 |
| Extraversion | 0.000 | 0.000 | 0.000 | 0.001 |
| Openness | 0.001 | 0.001 | 0.000 | 0.000 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

## 4. TIPI Results - Twofold decomposition

Table 7: **Maths SDQ** Results - Twofold decomposition

| | **Maths points** | | | |
|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** |
| Female (Group 1) | 9.685*** | 9.685*** | 9.685*** | 9.685*** |
| Male (Group 2) | 9.803*** | 9.803*** | 9.803*** | 9.803*** |
| Difference | -0.118* | -0.118* | -0.118* | -0.118* |
| Explained | -0.244*** | -0.237*** | -0.227*** | -0.225*** |
| Unexplained | 0.126** | 0.119** | 0.109** | 0.107** |
| **Explained** | | | | |
| Vocal reasoning | -0.071*** | -0.056*** | -0.066*** | -0.055*** |
| Numerical ability | -0.197*** | -0.183*** | -0.192*** | -0.181*** |
| Matrices | -0.016* | -0.015* | -0.016* | -0.015* |
| Emotional symptoms | -0.018** | -0.013* | -0.017** | -0.013* |
| Conduct problems | 0.002 | 0.002 | 0.002 | 0.002 |
| Hyperactivity/Inattention | 0.056*** | 0.057*** | 0.058*** | 0.058*** |
| Peer-relationship problems | 0.000 | 0.000 | -0.000 | -0.000 |
| **Unexplained** | | | | |
| Vocal reasoning | 0.015 | -0.023 | 0.037 | -0.009 |
| Numerical ability | -0.221 | -0.146 | -0.144 | -0.108 |
| Matrices | 0.266 | 0.115 | 0.127 | 0.044 |
| Emotional symptoms | -0.042 | -0.126 | -0.029 | -0.106 |
| Conduct problems | 0.563 | 0.664 | 0.666 | 0.708* |
| Hyperactivity/Inattention | 0.231 | 0.209 | 0.224 | 0.200 |
| Peer-relationship problems | -0.120 | -0.100 | -0.160 | -0.118 |
| Constant | -0.567 | -0.570 | -0.519 | -0.549 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

## B. Gendered Patterns in Cognitive and Noncognitive Influences on Academic Performance

Table 8: **English SDQ** Results - Twofold decomposition

| | **English points** | | | |
|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** |
| Female (Group 1) | 10.402*** | 10.402*** | 10.402*** | 10.402*** |
| Male (Group 2) | 10.091*** | 10.091*** | 10.091*** | 10.091*** |
| Difference | 0.310*** | 0.310*** | 0.310*** | 0.310*** |
| Explained | -0.119*** | -0.114*** | -0.107*** | -0.105*** |
| Unexplained | 0.429*** | 0.425*** | 0.418*** | 0.416*** |
| **Explained** | | | | |
| Vocal reasoning | -0.081*** | -0.075*** | -0.079*** | -0.074*** |
| Numerical ability | -0.082*** | -0.075*** | -0.078*** | -0.073*** |
| Matrices | -0.004 | -0.003 | -0.004 | -0.003 |
| Emotional symptoms | -0.004 | -0.001 | -0.003 | -0.001 |
| Conduct problems | -0.000 | -0.000 | -0.000 | -0.000 |
| Hyperactivity/Inattention | 0.047*** | 0.048*** | 0.048*** | 0.048*** |
| Peer-relationship problems | 0.005* | 0.005 | 0.005 | 0.005 |
| **Unexplained** | | | | |
| Vocal reasoning | -0.111 | -0.149 | -0.098 | -0.139 |
| Numerical ability | -0.062 | -0.038 | -0.027 | -0.020 |
| Matrices | 0.069 | 0.003 | 0.022 | -0.012 |
| Emotional symptoms | 0.006 | -0.033 | 0.013 | -0.023 |
| Conduct problems | 0.076 | 0.123 | 0.156 | 0.177 |
| Hyperactivity/Inattention | -0.088 | -0.100 | -0.104 | -0.119 |
| Peer-relationship problems | 0.038 | 0.050 | 0.012 | 0.035 |
| Constant | 0.501 | 0.431 | 0.399 | 0.295 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

Table 9: **Maths TIPI** Results - Twofold decomposition

| | **Maths points** | | | |
|---|---|---|---|---|
| | **I** | **II** | **III** | **IV** |
| Female (Group 1) | 9.685*** | 9.685*** | 9.685*** | 9.685*** |
| Male (Group 2) | 9.803*** | 9.803*** | 9.803*** | 9.803*** |
| Difference | -0.118* | -0.118* | -0.118* | -0.118* |
| Explained | -0.289*** | -0.281*** | -0.272*** | -0.268*** |
| Unexplained | 0.171*** | 0.163*** | 0.153*** | 0.150*** |
| **Explained** | | | | |
| Vocal reasoning | -0.077*** | -0.062*** | -0.072*** | -0.061*** |
| Numerical ability | -0.209*** | -0.193*** | -0.202*** | -0.191*** |
| Matrices | -0.016* | -0.015* | -0.016* | -0.015* |
| Agreeableness | 0.002 | 0.004 | 0.002 | 0.004 |
| Conscientiousness | 0.021*** | 0.021*** | 0.022*** | 0.022*** |
| Emotional stability | -0.004 | -0.003 | -0.004 | -0.003 |
| Extraversion | -0.001 | -0.001 | -0.001 | -0.001 |
| Openness | -0.004 | -0.002 | -0.003 | -0.002 |
| **Unexplained** | | | | |
| Vocal reasoning | 0.041 | -0.002 | 0.068 | 0.014 |
| Numerical ability | -0.204 | -0.128 | -0.125 | -0.091 |
| Matrices | 0.304 | 0.155 | 0.178 | 0.091 |
| Agreeableness | -0.030 | 0.028 | -0.021 | 0.027 |
| Conscientiousness | 0.136 | 0.075 | 0.121 | 0.071 |
| Emotional stability | -0.018 | 0.007 | 0.000 | 0.015 |
| Extraversion | -0.012 | 0.010 | -0.012 | 0.009 |
| Openness | -0.052 | -0.057 | -0.074 | -0.067 |
| Constant | 0.006 | -0.014 | 0.116 | 0.033 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

Table 10: **English TIPI** Results - Twofold decomposition

| | **English Points** | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| Female (Group 1) | 10.402*** | 10.402*** | 10.402*** | 10.402*** |
| Male (Group 2) | 10.091*** | 10.091*** | 10.091*** | 10.091*** |
| Difference | 0.310*** | 0.310*** | 0.310*** | 0.310*** |
| Explained | -0.161*** | -0.156*** | -0.149*** | -0.147*** |
| Unexplained | 0.471*** | 0.466*** | 0.460*** | 0.457*** |
| **Explained** | | | | |
| Vocal reasoning | -0.085*** | -0.078*** | -0.083*** | -0.077*** |
| Numerical ability | -0.090*** | -0.082*** | -0.085*** | -0.080*** |
| Matrices | -0.004 | -0.004 | -0.004 | -0.004 |
| Agreeableness | 0.004 | 0.005 | 0.004 | 0.005 |
| Conscientiousness | 0.014*** | 0.014*** | 0.014*** | 0.014*** |
| Emotional stability | -0.001 | -0.000 | -0.001 | -0.000 |
| Extraversion | 0.001 | 0.001 | 0.001 | 0.001 |
| Openness | 0.000 | 0.002 | 0.001 | 0.002 |
| **Unexplained** | | | | |
| Vocal reasoning | -0.112 | -0.153 | -0.095 | -0.141 |
| Numerical ability | -0.097 | -0.072 | -0.061 | -0.056 |
| Matrices | 0.060 | -0.006 | 0.020 | -0.017 |
| Agreeableness | -0.097 | -0.064 | -0.084 | -0.055 |
| Conscientiousness | 0.037 | 0.009 | 0.030 | 0.006 |
| Emotional stability | -0.024 | -0.012 | -0.021 | -0.015 |
| Extraversion | 0.018 | 0.027 | 0.021 | 0.031 |
| Openness | 0.026 | 0.021 | 0.006 | 0.007 |
| Constant | 0.660* | 0.583* | 0.605* | 0.477 |
| **SES Controls:** | No | Yes | No | Yes |
| **School Controls:** | No | No | Yes | Yes |
| Observations | 3,783 | 3,783 | 3,783 | 3,783 |

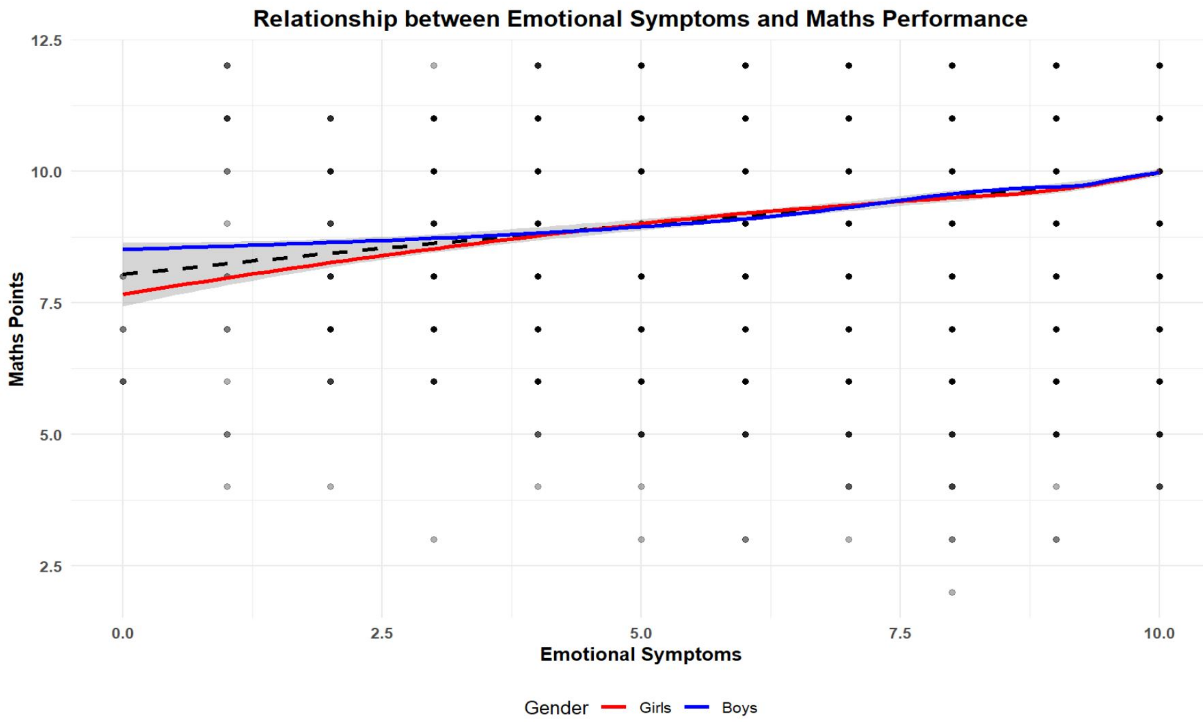


Figure 8: Figure 8 shows a slight positive relationship between Emotional Symptoms and Maths performance. There appears to be a small gender difference in this relationship at the lower end (where boys and girls have lower levels of Emotional Symptoms), which indicates that lower levels of Emotional Symptoms affect girls' Maths performance more than boys'.

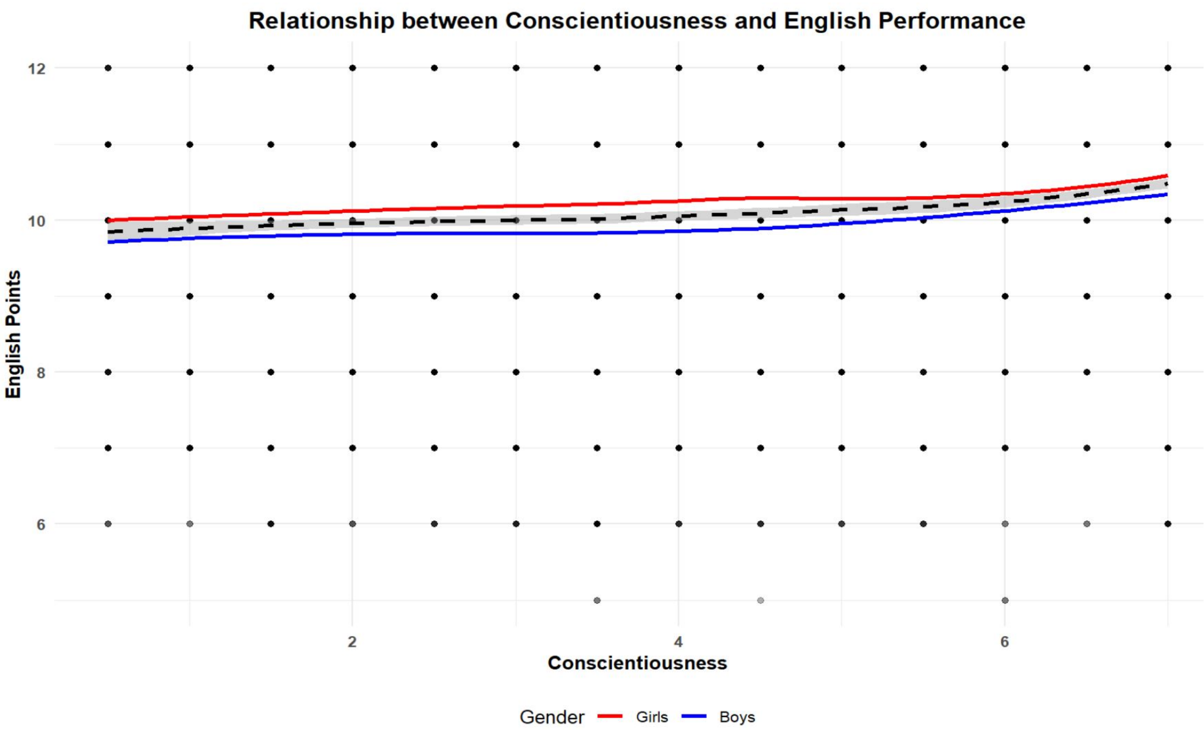


Figure 9: Figure 9 exhibits a positive relationship between Conscientiousness and English performance. As with Maths, boys show a slightly steeper curve at higher levels of Conscientiousness, suggesting that high Conscientiousness might be particularly beneficial for boys' English performance, and it would help close the gender achievement gap.

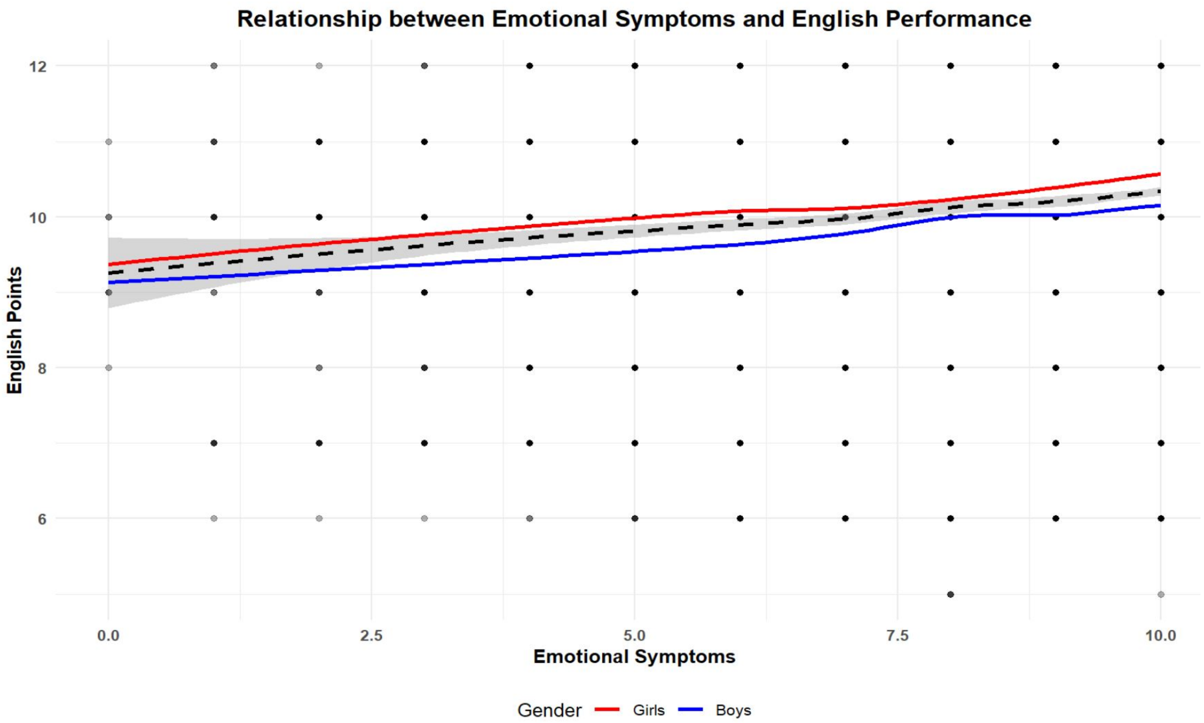


Figure 10: Figure 10 reveals a positive relationship between Emotional Symptoms and English performance, with a small, but apparent, gender difference (it is more pronounced for girls).

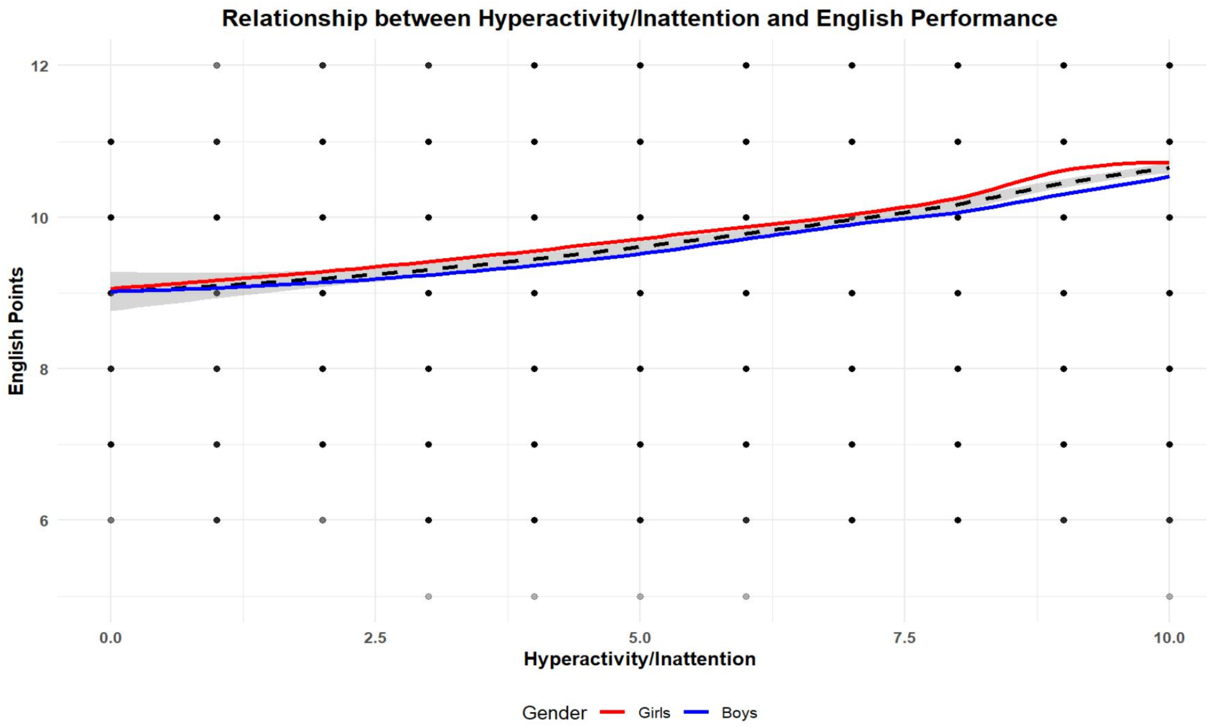


Figure 11: Figure 11 displays a positive relationship between Hyperactivity/Inattention and English performance, similar to Maths (where the original SDQ sub-scale was inverted, so low levels of Hyperactivity/Inattention in the graph mean lower levels of control, balance, and attention). Higher levels of Hyperactivity/Inattention (or higher levels of attention and control) are also associated with higher English performance (proxied by points) especially for boys at higher levels of Hyperactivity/Inattention. This consistency across subjects highlights the importance of addressing attention-related issues, particularly for boys.