Quantifying *Habitus*: A starting point for measuring educational outcomes in mathematics.

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Quantifying *Habitus*: A starting point for measuring educational outcomes in mathematics.

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Abstract

Mathematics continues to serve as a critical gateway to further education and career opportunities (National Numeracy, 2023). However, international comparisons such as TIMSS and PISA reveal persistent underperformance in mathematical attainment in the UK compared to countries like Singapore and China. In response, the UK implemented the 2016 Teacher Exchange Programme and adopted the mastery method of teaching, aiming to raise national attainment levels. Yet, longitudinal evaluations revealed limited success, highlighting the need to consider the social and cultural dimensions that influence pupil outcomes (Boylan *et al*, 2019).

This quantitative study addresses this gap by introducing and operationalising the concept of *Mathematical Habitus*, drawing on Bourdieu's theory of practice (1977) and framed through a critical realist lens. The study applies the Harris Dispositional Framework to investigate how demographic, social, and cultural factors shape mathematical dispositions and practices. Data were collected from 10 secondary schools in North West England, including 1,759 Year 9 pupils, 341 parents, and 62 mathematics teachers.

Validated measures were developed to assess pupils', parents' and peer attitudes toward mathematics, In-School and Out-of-School Value, Mathematical Relevance, Mathematical Confidence and *Mathematical Habitus*. Regression and multilevel modelling were used to identify the strongest predictors of *Mathematical Habitus*.

Findings show that gender, ethnicity, and parent and peer attitudes significantly influence *Mathematical Habitus*. Pupils' perceptions of the value and relevance of mathematics emerged as key factors. The study also raises concerns about the inadequacy of current data collection methods used in educational policy and research, which often fail to reflect pupils' lived experiences. Consequently, many interventions risk being ineffective or reinforcing existing inequalities.

This research contributes a replicable methodological framework, advances theoretical understanding of mathematical practices, and calls for further large-scale research to better inform educational practice.

Chapter 1: Introduction

This chapter sets the foundation for the study by outlining its central focus: the exploration of how demographic and socio-cultural factors shape pupils' dispositions towards mathematics and in turn, influence their mathematical practices and outcomes. It begins by reflecting on the researcher's own positionality, acknowledging how personal and professional experiences have been the motivation for the research and influenced the research design. It then continues by situating the research in the broader educational context, highlighting a gap in the literature where intersecting influences are often overlooked or treated in isolation.

The chapter continues by addressing issues with the measurement of attainment across research and policy contexts and the need for a more complex and reliable form of measure. The chapter then introduces the theoretical framework that underpins the study, Bourdieu's Theory of Practice '(*Habitus* x Capital) + Field = Practice' (1977:101), and explains how it informs the methodological and theoretical approach. This framework supports the development of a series of measurements that captures key constructs, such as pupil, peer, and parental attitudes, pupils' In-School Value, Out-School Value, Relevance and Confidence of mathematics, and the overarching concept of *Mathematical Habitus*.

Finally, the chapter outlines the rationale for the study, presenting the research questions and aims. These are designed to uncover the key predictors of *Mathematical Habitus* and contribute to a more complex understanding of the factors that influence educational outcomes in mathematics.

Defining key concepts

Throughout this thesis, Bourdieu's concept of *habitus* (Bourdieu, 1977) serves as a central theoretical concept, therefore it is important to clarify how this work is defining and applying this term. In this thesis, *habitus* is understood as a set of socially acquired dispositions, influenced by an individual's place in the social system and has its roots in family upbringing. They are "a system of lasting, transposable dispositions which, integrating past experience, function at every moment as a matrix of perceptions, appreciations and actions" (Bourdieu 1977:

82). These dispositions are not fixed traits but dynamic tendencies that guide behaviour and practice.

Building on this foundation, the research develops the concept into *Mathematical Habitus*. *Mathematical Habitus* refers to the interplay between dispositions, capital, and demographic factors within the field of mathematics education. It captures how individuals' socio-cultural backgrounds and experiences influence their mathematical practices.

To operationalise this concept, the thesis introduces the Harris Dispositional Framework, which identifies four key dispositions toward mathematics: In-School Value, Out-School Value, Relevance and Confidence. These four dispositions form the dispositional component of *Mathematical Habitus*. When considered alongside demographic variables and forms of capital, they provide a measurable framework for analysing how *Mathematical Habitus* manifests and influences mathematical practices.

My Positionality

This research has been shaped by my personal experiences within the education systems of both England and China. I come from a working-class background and grew up on a council estate in Warrington, where my parents often told me, *"You don't need GCSEs to get a job; look at us, we turned out fine."* However, influenced by my school and teachers, I did not take this statement at face value. I began to understand how passing GCSE Mathematics could help me secure a 'good job' and earn 'good money' as I got older. I wanted to be in a better position than those around me - to be able to go on holidays, buy nice clothes, and have a nice car and house. I remember telling my parents, *"Things have changed since you were kids."*

Despite the conflicting messages I received at home and in school, my views were ultimately shaped more by my teachers and the opportunities presented to me at school. This motivated me to do my best in my exams. As a result, I achieved a B in GCSE Mathematics, exceeding the pass mark required to progress to Sixth Form college. I vividly remember my teacher being as shocked as I was; in my mock exams, I had been achieving E's and U's because I never revised. To me, mocks didn't seem important, I preferred to enjoy my free time, as my parents encouraged. However, when it came to the final GCSE Mathematics exams, I recognised the significance of achieving at least a C, realising it could open doors to that ‘good job’ I aspired to in the future.

These personal experiences, the influence of parents, school, and teachers throughout my educational journey, have directly informed the design of this research. They underpin the aim to explore how these different influences shape pupils’ *Mathematical Habitus*, particularly when they may be in conflict.

It was compulsory to stay in education until the age of 18, and at that point, I found myself facing a similar dilemma. The people around me were planning to go to university, while I didn’t even know what an undergraduate or postgraduate degree was. I was determined to get an apprenticeship because I was fed up with having no money - something my parents constantly reminded me of, saying, *“Qualifications don’t mean anything; half of those who go to university end up working in Tesco anyway.”* Influenced by these views, I once asked my form tutor, *“Where is Sociology going to get me in life?”*

The value and relevance of a subject meant a lot to me. Would it help me get the ‘good job’ I wanted? No one in my family or social circle had ever been to university, but my teacher encouraged me to attend open days to find out more. To be honest, at first the idea of an open day just sounded like a good excuse to get a day off college. However, through the opportunity to attend these events, I began to realise that I actually did want to study Sociology at university. I found out I was entitled to student finance, which meant I would have money to live on, and maybe one day I could get that ‘good job’ and even become a lecturer.

Again, the opportunities presented to me by my school and teachers overrode my parents’ influence on my outlook and decisions about education. I went on to study at university and specialised in Quantitative Methods, which I thoroughly enjoyed. It took me back to my school days when I never understood why I had to learn maths - *“I’m never going to use this in everyday life,”* I used to think. Back then, I believed mathematics was only useful for getting me into college or helping me secure a job. However, at university, Quantitative Methods felt completely different. I could clearly see its application to everyday life and various jobs, and I believed this was the kind of ‘maths’ people should be learning, maths that provides practical skills relevant to real-world contexts and future careers.

I realised that this question of relevance had continually surfaced throughout my educational journey: how connected the content I was learning felt to my life outside of school or university, and how valuable it seemed for helping me progress towards further study or work. The socio-cultural context mattered. Throughout my journey, different influences and motivations at different stages shaped my educational outcomes.

I graduated from university with a first-class honours degree and began teaching English at a kindergarten in China. The education system there was unlike anything I had experienced before. Parents were highly involved in their children’s studies, and many children took part in multiple extracurricular activities after a full nine-hour school day from piano and ballet, to extra English lessons. This experience highlighted distinct socio-cultural differences in classrooms and amongst parents, something I had never witnessed before. The children I taught were socio-economically advantaged, but they were also part of a culture that placed intense value on education and achievement.

Unfortunately, my time in China was cut short due to the COVID-19 pandemic in 2020. When I returned to England, I decided to continue my teaching journey and specialised in teaching Secondary Mathematics. During my PGCE, I completed placements at two very different schools. My first school was in an affluent area where most pupils worked hard at mathematics and did not see it as a problem. In contrast, my second placement was in a highly disadvantaged area and was attached to an Alternative Provision school - a setting for pupils who had been permanently excluded from mainstream school or needed additional support.

Teaching these pupils Key Stage 3 and GCSE Mathematics highlighted deep-rooted inequalities. Many students were disinterested, often asking, *“What’s the point of this?”* They rarely completed their work, and it became evident this was due to their low mathematical ability. Most had experienced disrupted educational journeys marked by low attendance, exclusions, or frequent school changes. Many had not even sat their SATs exams at key stage 2. As their teacher, I was expected to continue delivering the standard curriculum, with no flexibility to adapt the content to their needs.

This curriculum was too challenging for them. They needed to start from the basics and rebuild their foundational mathematical skills. I strongly disagreed with what I was being asked to do. Why were these pupils not given the option to sit Functional Skills Mathematics instead of GCSE Mathematics? Functional Skills focuses on content relevant to the workplace, helps develop practical everyday skills, and is designed to build confidence and positive attitudes towards mathematics (DfE, 2024d).

This experience left me frustrated and angry. The Department for Education's guidelines and teacher training did not, and still do not, acknowledge the need for a differentiated curriculum for pupils requiring additional support (DfE, 2021). It is no surprise, then, that the attainment gap between socio-economically advantaged and disadvantaged pupils continues to grow (DfE, 2022; DfE, 2024g). These pupils did not have the same opportunities or consistent school support as others, and this profoundly affected their educational outcomes.

Ultimately, this frustration turned into motivation, the driving force behind this research. It aims to better understand how pupils' socio-cultural backgrounds impact their learning, *habitus*, and educational trajectories.

During my time completing my PGCE, the term *'mastery'* was widely used, but no one really knew what it meant. It became a buzzword: simply saying we were teaching for 'mastery' was enough to tick a box. In practice, this often meant presenting a slide at the end of a lesson with an application-style question, which we rarely reached due to time constraints.

It soon came to my attention that significant funding had been allocated to implement the 'mastery' approach in schools, with the belief, according to the government, that this would miraculously increase pupils' attainment. I found this hard to believe. From my teaching experiences in both China and England, I saw two completely different educational cultures with very different attitudes towards learning. In China, it was an expectation that every child would do well, not just in maths but across their entire education. Struggling or having special educational needs was a taboo subject, rarely discussed openly because of family stigma. In contrast, in England it is socially acceptable to be “bad at maths” (National Numeracy, 2023), and many students adopt an anti-maths mindset (Gov, 2023).

While England does acknowledge the needs of pupils with special educational needs, it does not adequately consider other disadvantages, such as eligibility for free school meals. The government’s decision to implement the ‘mastery’ method, assuming it would replicate China’s high mathematics attainment, completely ignored the social and cultural context in which English pupils learn (Boylan *et al*, 2017). In a society where it is acceptable to claim you are “bad at maths” and people wear being bad at maths as a “badge of honour” (Sharp, 2017; Kowsun, 2008, cited in National Numeracy, 2023), this approach seemed fundamentally flawed.

Reflecting on this, I thought back to my own childhood. Unlike many around me who followed their parents’ advice, I chose to listen to my teachers. Why did I look at education differently? What influenced me to make that choice? And how could the government believe that simply importing a teaching method from China would improve attainment for all pupils in England, without considering their diverse backgrounds and contexts?

My personal and professional experiences as a secondary mathematics teacher and as a pupil whose parents did not see value in GCSE qualifications, have directly shaped the key themes of this research. In particular, I have become deeply interested in understanding the value and relevance of the mathematics curriculum from the perspective of pupils, and how their socio-cultural experiences within the ‘field’ of education impact their *Mathematical Habitus* and practices (Edgerton *et al*, 2013). A central aim of this research is to find a more valid and reliable way to measure this impact.

Ultimately, pupils who do not achieve a grade 4 or above in GCSE mathematics are denied access to many further education courses and careers unless they resit the exam later. This increases the likelihood of them dropping out of education altogether by age 18 (Education Policy Institute, 2019). The Education Policy Institute refers to these pupils as *‘the forgotten third’*, as around 36% do not achieve a grade 4 or above in English and mathematics. These students are disproportionately those eligible for free school meals, those who speak English as an additional language, and those with low parental engagement, and their outcomes also depend on the effectiveness of the schools they attend.

Identifying the factors that contribute to pupils failing to obtain a pass in GCSE mathematics highlights an urgent need for reform. It also underscores the potential positive role that Functional Skills mathematics could play for these pupils. Functional Skills focuses on core mathematical concepts needed for most workplaces and everyday life (DfE, 2024d). The disparity between what is needed (practical, functional skills) and what is currently taught (a wide range of often abstract mathematical topics) negatively impacts pupils' future opportunities (Education Policy Institute, 2019).

This highlights a critical gap in knowledge that must be addressed: the value and relevance of the current mathematics curriculum, and how this, alongside pupils' confidence and socio-cultural contexts, impacts their *Mathematical Habitus*, practices, and outcomes.

Mathematics and Everyday Maths

Mathematics (commonly referred to as 'maths') is used as an umbrella term to encompass a wide range of related disciplines such as numeracy, algebra, trigonometry and statistics, whereas 'everyday day maths' refers to the maths that is useful for the workplace (DfE, 2024d). Throughout government documents there has been acknowledgement of these differences (DfE, 2012; 2021; 2024d), yet the mathematics curriculum content remains unchanged.

Achieving a grade 4 or above in the General Certificate of Secondary Education (GCSE) Mathematics is widely regarded as a prerequisite for accessing further education and many career pathways (National Numeracy, 2023). For those who do not meet this benchmark, mathematics often becomes a major barrier to further study, career opportunities, and social mobility. This barrier disproportionately affects pupils eligible for free school meals, those from White and Black ethnic backgrounds, and is strongly influenced by the quality of the school they attend and their family circumstances (Education Policy Institute, 2019). However, there is a growing disconnect between the mathematical content taught at GCSE level and the practical everyday mathematics skills required in the modern workforce (DfE, 2024d). The curriculum often emphasises abstract or advanced topics, such as algebra and geometry, whereas most of the post-16 education and employment contexts require only fundamental mathematical skills (such as arithmetic) that occupy a relatively minor portion of the current GCSE exam. This misalignment raises important questions about the relevance and purpose of the mathematics curriculum (Tomlinson, 2004; Voderman *et al*, 2011), especially as Gravemeijer *et al* (2017) highlights that many mathematical tasks traditionally performed by humans are now performed by machines; something that AI will further advance.

In sectors such as nursing, where a mathematics qualification is typically required to gain access, Level 2 Functional Skills Mathematics is often accepted as an alternative to GCSE. Functional Skills places greater emphasis on everyday mathematics and real-world problem-solving, thereby offering a more accessible route for many learners (DfE, 2024d). This alternative pathway gives more individuals the opportunity to progress into their chosen fields. Nonetheless, if Functional Skills are sufficient for career entry and further education courses, this highlights a misalignment between the broader demands of the GCSE mathematics curriculum and the actual prerequisites for success in many professions. The significant proportion of learners who fail to attain a passing grade in GCSE Mathematics - 28% of all pupils in 2023/24 (DfE, 2024a) are subsequently hindered in their progression to further education, as GCSE mathematics remains a pivotal factor in shaping young people’s future opportunities. A grade 4 pass at GCSE mathematics is a typical prerequisite of entry to apprenticeships, FE and HE programmes. Failing GCSE mathematics often causes high anxiety and low confidence with numbers, limiting their own career prospects and social mobility (National Numeracy, 2023). National Numeracy (2023) revealed that 22% of adults identify that by not achieving at least a Level 2 qualification in mathematics has negatively impacted their career, contributing to what they term a national "Numeracy Crisis”, caused by high anxiety and low confidence which continues into adulthood (National Numeracy, 2023). Due to these issues, it is important to distinguish between ‘everyday maths’, the ability to apply basic mathematical concepts to everyday life and the workplace, and ‘mathematics’, the wider range of interrelated topics and more abstract, theoretical understanding of numbers and patterns.

There is growing concern over the distinction between numeracy and mathematics. Numeracy refers to the confidence and ability to apply basic mathematical skills in everyday life and the workplace. This includes feeling capable of applying for jobs involving numbers or data, confidently managing personal finances, and effectively planning journeys or managing time (National Numeracy, online). In schools, numeracy originates from the 'number' topic within the mathematics curriculum, yet it is often overshadowed by more complex mathematical concepts. As a result, pupils tend to conflate numeracy and mathematics under the same umbrella, which contributes to heightened anxiety and low confidence when working with numbers (National Numeracy, 2023). According to National Numeracy (2021), this widespread anxiety and lack of confidence costs the UK an estimated £25 billion annually in lost earnings, as individuals with low numeracy skills are more vulnerable to job loss and demonstrate poorer financial behaviours, such as difficulties paying bills and saving money. Curtain-Phillips (2016) further highlights that individuals with negative attitudes toward mathematics often exhibit lower levels of numeracy, reduced financial literacy, and higher levels of personal debt.

Despite numerous working groups and researchers calling for curriculum reform (for example, Smith *et al*, 2004; Tomlinson, 2004; Voderman *et al*, 2011) the curriculum remains unchanged despite the reliance on ‘everyday maths’ rather than ‘mathematics’ in workplaces. This calls into question whether the existing curriculum adequately prepares learners for real-world demand, and why no changes have been made although attainment gaps continue to rise, especially amongst those that are socio-economically disadvantaged (The Sutton Trust, 2016; 2024).

There is already a case for revising the GCSE Mathematics curriculum, with this thesis aiming to add a layer to this to better understand how socio-cultural factors impacts pupils’ perception of the value and relevance of the curriculum, and how this impacts *Mathematical Habitus* and educational outcomes.

The issue with measuring attainment

Any discussion regarding curriculum reform and educational outcomes must also consider the issue with measuring attainment. Since the introduction of school league tables in 1992, designed to provide parents with information to inform school choice and to support Ofsted inspections (Leckie and Goldstein, 2017), the ranking of institutions based on GCSE pass rates has led to an increasing preoccupation with recording and improving attainment metrics, particularly in relation to international league tables. This focus has fuelled a culture of competition amongst schools, parents and government, where success is narrowly defined by the percentage of students achieving a grade 4 or above in GCSE Mathematics (DfE, 2024d). While this measure of attainment provides a baseline indicator of performance, it fails to differentiate between those meeting the minimum standard and those excelling, particularly at the higher grade levels required for access to advanced courses and such as Science, Technology, Engineering and Mathematics (STEM).

There have been efforts to boost female participation in STEM disciplines as attainment data shows that more females than males, 73.7% of females and 64.2% of males, achieve a grade 4 or above in GCSE Mathematics (McGee, 2024; Census, 2024). However, this statistic does not reflect the amount of males and females that study STEM subjects post-16. These figures conceal the proportion of each gender attaining the top grades necessary for progression into STEM related study and careers (McGee, 2024). This limitation reflects a broader trend across educational statistics, where data is often separated by demographic factors such as gender or ethnicity to inform comparisons of attainment levels between groups, yet fails to consider the impacts of wider social and cultural factors and the intersection between them that influence educational outcomes (DfE, 2012; 2024b; The Sutton Trust, 2024).

Boylan *et al* (2019) argues for a more complex approach that incorporates social and cultural factors into our understanding of attainment levels. This thesis addresses that gap, contributing to the conversation by exploring how socio-cultural factors interact with each other and provides a complex framework to measure this impact on mathematical dispositions. To support this exploration, it is necessary to establish a theoretical framework that can account for these socio-cultural relations.

Introducing the theoretical framework

The theoretical framework underpinning this research is grounded in Bourdieu's Theory of Practice (1977), which offers a powerful lens for exploring the social and cultural factors that shape mathematical practices and outcomes. Central to this framework are the interrelated concepts of *habitus*, capital, field, and practice, which together offer a lens to understand how educational inequalities are reproduced. Bourdieu's formula '(*habitus* × capital) + field = practice' (1977: 101) serves as a conceptual tool for analysing how individuals' dispositions and access to various forms of capital interact with the field of mathematics education to influence practices and outcomes in mathematics education.

While this research places particular emphasis on *habitus*, it acknowledges that all four concepts must not be considered in isolation and instead must be used in conjunction. In this research these concepts are collectively operationalised to construct a quantitative measure of *Mathematical Habitus*, which is then used to examine how pupils' socio-cultural factors shape their mathematical dispositions that inform their practices (Bourdieu, 1977; Edgerton *et al*, 2013).

Bourdieu's theoretical contributions have been widely adopted within the sociology of education to explain persistent patterns of inequality (see for example, Reay, 2004, 2017, 2020; Ingram, 2009, 201; Friedman, 2014, 2016). Central to Bourdieu's critique is the idea that education functions as a mechanism for the reproduction of social inequalities, primarily through the unequal distribution and recognition of capital. As Bourdieu and Passeron (1990) argue, credentials are unevenly allocated in ways that privilege those who inherit middle-class forms of cultural and social capital. This framework provides a means to operationalise and move beyond demographic comparisons to instead examine the deeper, interconnected influences, situated within the field of mathematics education that impacts on mathematical practices.

The importance of dispositions on practice

In Bourdieu's Theory of Practice (1977), Bourdieu explains *habitus* to be a set of dispositions shaped by an individual's social position and early life experiences, particularly within the family. Bourdieu describes *habitus* as "a system of lasting, transposable dispositions which, integrating past experience, function at every moment as a matrix of perceptions, appreciations and actions and makes possible the achievement of infinitely diversified tasks” (Bourdieu, 1977: 82). Through primary socialisation and environmental influences, individuals develop a schema through which they interpret the world and respond to it, with past experiences playing a key role in shaping present behaviour (Kennedy, 2012; Edgerton and Roberts, 2014). These ingrained dispositions reflect the interaction between an individual's social and cultural capital, providing a lens through which to understand the complexity of mathematical practices.

Edgerton and Roberts (2014) argue that an individual’s behaviour and practices in schools emerge from the interaction between their *habitus* and capital within a given field. For this research, we refer to the field as mathematics education. These interactions are influenced by multiple factors, including socioeconomic status, cultural background, family upbringing, and peer relationships, all which shape pupils' dispositions and consequently their educational practices. Furthermore, Edgerton *et al* (2013) highlight that academic practices are positively associated with academic outcomes that are closely linked to students' ability to navigate the norms and expectations of the educational field. However, such proficiency is unevenly distributed, as dispositional tendencies vary significantly across social groups. Their findings emphasise the strong influence of *habitus* on educational practices and outcomes, particularly in contexts like mathematics, where success often aligns with the dominant cultural values of the field. The Harris Dispositional Framework is a tool designed to measure four dispositions towards mathematics: In-School Value, Out-School Value, Relevance and Confidence, and offers a framework to explore how socio-cultural factors shape *Mathematical Habitus*.

The relationship between attitudes and dispositions

Attitudes are defined as learned predispositions that incorporates beliefs, emotions, and behavioural tendencies towards a particular subject (Thurstone, 1928, as cited in Fishman *et al*, 2021). In contrast, dispositions are the internalised set of beliefs, values, and practices that shape how an individual interprets, behaves and engages with the social world (Bourdieu, 1977). These internalised dispositions form the core of what Bourdieu conceptualises as *habitus*, which is shaped by an individual’s position within the social structure. According to Edgerton and Roberts (2014), an individual’s actions within a specific field, such as a school, are the result of the dynamic interaction between their *habitus* and the forms of capital they possess. These interactions are influenced by a range of factors, including socioeconomic status, cultural background, family upbringing, and peer relationships. Such influences shape an individual's dispositions, which in turn guide their educational practices.

The relationship between attitudes and dispositions is closely intertwined. However, there are inconsistencies and disagreements among researchers regarding what constitutes an attitude versus a disposition, and how each informs behaviours, beliefs, and values (Bourdieu, 1977; Beyers, 2008; Edgerton and Roberts, 2014). In this research, the approach taken is that attitudes inform dispositions. This is grounded in the theoretical framework of *habitus*, which refers to an internalised set of dispositions that shape behaviour and practices (Bourdieu, 1977; Bourdieu and Wacquant, 1992). In contrast, attitudes are understood as predispositions that incorporate beliefs and feelings (Thurstone, 1918, cited in Fisherman *et al*, 2021). Attitudes can be shaped by external influences such as parents, peers, and teachers, and once internalised, they become part of an individual’s *habitus* as dispositions that subsequently influence practices (Edgerton *et al*, 2013). Recognising this interconnection is essential for understanding how pupils’ orientations towards learning, particularly in mathematics, are formed and how they contribute to broader educational outcomes.

The need to identify how social and cultural factors impact mathematical practice

This thesis highlights a persistent gap in the grey literature concerning the understanding of the ways in which pupils’ demographic, social, and cultural factors shape educational outcomes (The Sutton Trust 2016, 2024; Boylan *et al,* 2017, 2019). Much of the existing literature and policy tends to focus on attainment differences between groups based on singular demographic variables, such as eligibility for free school meals or ethnic background (see for example, The Sutton Trust, 2024; Education Policy Institute, 2024). While such analyses have informed the development of interventions to support those pupils’ that have lower attainment levels, they often rely on bivariate methods that lacks nuance and complexity of the issues. In contrast, much academic literature within education research does acknowledge this complexity and uses multivariate analysis techniques to uncover these complexities (Beroiza-Valenzuela, 2025; Mcmaster, 2017; Shackleton *et al*, 2018). However, official government reports still lack this depth of analysis which fails to reflect the complex nature of pupils' everyday experiences and highlights the need for the more sophisticated models to be used alongside more collaboration with academics, to more accurately investigate the social realities pupils navigate. Such models would allow for more valid and reliable interpretations of data and more effective policy recommendations.

This issue is exemplified in Boylan *et al's* (2019) longitudinal evaluation of the teacher exchange programme, which found that the implementation of the 'mastery' approach to teaching mathematics did not lead to the anticipated improvements in mathematics attainment. Boylan *et al* (2019) attributed this to a failure to account for the social and cultural contexts of pupils. Nonetheless, despite these findings, the 'mastery' method continues to be promoted and implemented across primary and secondary schools in England (Maths Hub Network, 2023; NCTEM, 2024b), illustrating a broader disconnect between evidence-based research and education policy. This highlights the need for research to acknowledge socio-cultural factors and for greater government engagement with research that acknowledges the complexities of educational inequalities.

Justifying the methodology

Much of Bourdieu's work is predominantly associated with qualitative research in education, where this perception often overlooks his engagement with quantitative methods. Bourdieu (1990) acknowledges that many scholars have mistakenly dismissed the empirical foundations of his theories, partly due to limitations in the translation of his texts. A closer reading of *Reproduction in Education, Society and Culture* (1990) reveals Bourdieu's own frustration with such misinterpretations, as he explicitly calls for his work to be read in conjunction with his many other works, and for the empirical research to be noticed. Furthermore, in *An Invitation to Reflexive Sociology* (Bourdieu and Wacquant, 1992), Bourdieu further clarifies that *habitus* is neither a product of pure agency nor entirely determined by structure but emerges through the interplay between the two over time. This understanding supports a more flexible approach to measuring *habitus* and the opportunity for it to change over time and through spaces.

Particular attention is drawn here to the preface of *Reproduction in Education, Society and Culture* (1990) where Bourdieu introduces ‘the educational career and its system of determinations’ model. This model illustrates how demographic factors, social and cultural capital, and external influences interact to shape educational outcomes. The directional arrows in the model represent correlations between variables, thereby justifying the use of quantitative methods such as structural equation modelling, regression analysis, and multilevel modelling. These approaches allow for the measurement of relationships between variables and the complexity of educational outcomes to be explored.

The need to measure Mathematical Habitus

Despite the implementation of numerous targeted interventions such as the *Ethnic Minority Achievement Grant* (1999), the *Education Act* (1988), and the National Tutoring Programme (The Sutton Trust, 2024), persistent inequalities in mathematics education remain. These initiatives often address demographic characteristics in isolation, failing to account for the complex interplay of social, cultural, and institutional factors that shape educational outcomes. Increasingly, research highlights the importance of examining these intersecting influences, as pupils’ mathematical outcomes are shaped by far more than cognitive ability alone (Dowker *et al*, 2019).

Bourdieu’s Theory of Practice (1977) offers a comprehensive framework for engaging with this complexity. His formula, (*habitus* x capital) + field = practice (Bourdieu, 1977: 101), provides a lens through which to understand how pupils’ internalised dispositions (*habitus*), access to various forms of capital, and the educational context (field) collectively influence mathematical outcomes. While this theoretical model has been widely applied in qualitative research (Reay 2004, 2017, 2020; Ingram, 2009, 2011; Friedman *et al*, 2015, 2016) there remains a notable gap in research that seeks to quantitatively operationalise these constructs, particularly within the field of mathematics education.

This research directly addresses that gap. By focusing on *Mathematical Habitus*, it aims to develop a quantitative framework for understanding how social and cultural factors shape pupils' mathematical practices, aligning with Edgerton *et al* (2013), who argue that such influences significantly affect educational outcomes. This research is designed to identify key predictors of a stronger *Mathematical Habitus*, using the Harris Dispositional Framework. This framework consists of four mathematical dispositions: In-School Value, Out-School Value, Relevance and Confidence which alongside pupil's socio-cultural factors measures pupils' *Mathematical Habitus.* This framework offers a starting point into a more valid and reliable method of measuring mathematical outcomes by acknowledging the complexity of learners educational journeys, and an understanding of the potential for this to impact their mathematical practices and outcomes. Uncovering these predictors is essential for informing schools and government on the impact of these factors on pupils' progression with mathematics to provide better support for these learners and contributing to a more equitable mathematics education. This is especially pertinent, given the role of mathematics as a gatekeeper to further education and employment opportunities (National Numeracy, 2023),

Research questions and aims

Research Question 1

Can we quantitatively measure *Mathematical Habitus*?

Aim: To quantitatively measure *Mathematical Habitus* based on Bourdieu's Theory of Practice and a system of careers and its determinations model.

Objective: To assesses reliability and validity of multi-item scales designed to measure In-School value, Out-School value, relevance and confidence of mathematics.

Research Question 2

What factors affect pupils In-School value, Out-School value, relevance and confidence of mathematics?

Aim: To assess whether different factors increase or decrease pupils' perception of the In-School value, Out-School value, relevance and confidence of secondary mathematics.

Objective: Use a series of bivariate tests and multi-linear regression to identify significant differences and relationships between independent variables and the In-School value, Out-School value, relevance and confidence of mathematics.

Research Question 3

What are the key predictors of a stronger *Mathematical Habitus*?

Aim: To assess what factors are the key predictors of stronger Mathematical Habitus.

Objective: To conduct regression and multi-level models to identify the most significant factors of higher *Mathematical Habitus*.

Chapter 2: Literature Review

This chapter outlines the contextual background and theoretical framework underpinning this research, with a focus on examining the various factors that influence educational outcomes. Specifically, it seeks to explore how these factors shape Mathematical *Habitus* and practices, highlighting a significant gap in existing research concerning the social and cultural influences on this issue. Much of the previous research has concentrated on attainment levels, often isolating single variables such as eligibility for free school meals, gender, or ethnicity, without considering the combined effects of these factors (The Sutton Trust 2016; Burgess *et al*, 2020; DfE, 2019a, 2019b, 2024b, 2024d;). This narrow focus overlooks the complex, interrelated ways in which a student's social and cultural background, including the influence of parents and peers, can shape their mathematical outcomes.

To provide a comprehensive lens for analysis, the chapter draws on a range of Bourdieu's texts (1977; 1984; 1990) and theoretical concepts of *habitus*, capital, field, and practice. These concepts offer a valuable framework for understanding how students' demographic and social and cultural backgrounds inform their dispositions and practices in mathematics. While prior studies (EEF, 2017; Hodgen *et al,* 2019) tend to prioritise attainment outcomes, this research shifts the focus toward *Mathematical Habitus* and practices, which, according to Edgerton *et al* (2013), are key determinants of educational outcomes, including attainment.

Finally, this chapter introduces the concept of *Mathematical Habitus*, defined as the set of dispositions students develop toward mathematics, shaped by their social and cultural capital. Understanding and measuring *Mathematical Habitus* is essential to fully grasp how students engage with mathematics and how their experiences and backgrounds influence this engagement.

Historical and Political Context of the Education System, Mastery and GCSE Mathematics

It is important to understand the historical and political context of mathematics education as it identifies how policy has informed changes in curriculum design and reform, and for the understanding how educational inequalities continue to exist. Mathematics is situated in a unique position in modern English society: you're either good at maths, or you're not. Snow's (1959) '*The Two Cultures'* identifies that this has been an issue for decades, due to the idea that a skillset in maths and a skillset in literacy are mutually exclusive, that still applies today. It is 'ok to be bad at maths' and socially acceptable to have an 'anti-maths mindset' (National Numeracy, 2016; Gov, 2023). This is further supported by Sharp (2017) that identifies that being bad at maths is worn as a badge as honour, which Rishi Sunak addressed in 2023 by acknowledging the needs to change the way we value maths in the country by increasing the compulsory age to study mathematics to 18 years old. The UK continues to have a bias towards literacy than mathematics (Nuffield Foundation, 2010), that can be identified throughout policy and reform attempts to 'upskill' since the post-war era.

The post-war period brought significant changes to mathematics education in the UK. The *Education Act 1944* made secondary school free for all and raised the school leaving age to 15. During this time, there was a shift away from a narrow focus on arithmetic and towards a greater emphasis on understanding and applying mathematical concepts. This change was driven by the perceived need for a more scientifically literate population, prompted by the war's impact on industry and technology. The curriculum was expanded to include geometry, probability and statistics and clearer distinctions between the primary and secondary mathematics curriculum were established (Breakell, 2001; Majewska *et al*, 2022). Given this context, it was expected that higher achievers in mathematics would master this more advanced material in order to develop the skills needed to serve society's post-war demands. The focus on cultivating mathematically proficient individuals that were essential for societal progression in the wake of the war, can still be seen today in education curriculum documents that consistently emphasise the need to challenge those who are already fluent, often overlooking the needs of those who struggle (DfE, 2021). It is no surprise that over time this has caused attainment gaps, especially amongst the socially disadvantaged which continue today (DfE, 2024b).

Prior to GCSE's being introduced in 1986, the General Certificate of Education Ordinary Level examinations (O Levels) had been in place in England since the early 1950's. O levels were only available for those who attended grammar and private schools and were only taken by the top 20% of the school population by academic ability. At that time, majority of children who attended school left without any formal qualifications (Patrick, 1996). In the mid 1960's, the Certificate of Secondary Education (CSE) was introduced with its aim to cater for pupils with a wider range of abilities and was designed to be less academically demanding. O levels continued that maintained the divide between those that were academically able and had the ability to go to university, and those that were not.

During the 1970's there was considerable pressure to merge the two systems due to concerns that the system was creating a class divide. Under the Labour government, Education Secretary Shirley Williams announced proposals for a merged GCSE system, which Keith Joseph decided to proceed with under the Conservative government in 1986. This was outlined in the *1988 Education Reform Act*, the same year the first GCSE exams took place and the introduction of the National Curriculum. GCSE exams included a much wider range of content due to the acknowledgment that these exams were for everyone, not just the top 20% of those academically able, with questions getting progressively more challenging as pupils progressed through the paper. Although the aim has been to create an inclusive curriculum that allows all pupils the opportunity to obtain a mathematics qualification, a significant proportion, approximately one-third of pupils (31% in 2024/25), still fail to achieve this today. This indicates that a substantial group of students continue to be excluded from attaining a mathematics qualification, highlighting the ongoing failure of curriculum inclusivity despite longstanding concerns raised since 1988 (Tomlinson, 2004; Voderman *et al*, 2011).

In 1992, school league tables were introduced to increase transparency and accountability in the education system. This fuelled the obsession of monitoring performance and gave a way to compare attainment levels between different schools which has since been developed to compare between countries (Brown and McNamara, 2011). League tables continue today and measure the percentage of pupils that achieve 5 Grade 9-4 (previously grades A*-C) in all subjects in which they sit a GCSE exam. This has allowed parents to make informed decisions regarding the schools they send their children according to these results (Leckie and Goldstein, 2017). Although originally introduced to promote transparency, school league tables have instead intensified competition among schools, as rankings significantly influence both admissions and institutional reputation. Schools with higher reputations often serve a different pupil demographic compared to those with lower rankings. Reay (2017) highlights that schools situated in areas of socioeconomic deprivation tend to have a higher proportion of working-class pupils, a factor that correlates with their lower positions in league tables, thereby reinforcing existing educational inequalities. In response to these inequalities and growing concerns of traditional academic pathways, policymakers have increasingly explored alternative educational routes designed to better accommodate a diverse student population and address skills shortages in the labour market.

Due to the growing concern about the relevance of academic studies to the workplace and the lack of technical skills, vocational GCSEs were introduced in 2002 where grades would go towards this national standard of league tables (Bell *et al*, 2006). Vocational GCSEs are qualifications that are practical and directly related to a specific job or career path. Most of them include a theoretical aspect and hands on learning which allows pupils to get a qualification and work experience by applying what they have learnt. Vocational GCSEs also allow pupils to undergo further study if they wish. Some examples of these are Health and Social Care, Leisure and Tourism and Applied ICT (Bell *et al*, 2006).

In 2003 under the Labour government, a Working Group was set up by ministers, led by Mike Tomlinson, in response to concerns about the effectiveness of GCSEs to prepare young people for further education, training and employment. The working group was to advise on the reform of the curriculum and assessment for 14- to 19-year-olds. From this, the 14-19 Curriculum and Qualifications Reform Report (2004) was produced. They identified that too many young people leave education lacking basic skills which was leaving employers spending large sums of money to teach the basics post education, and a reduction in motivation from pupils as they progressed through the education system (Tomlinson, 2004). The Working Group put forward recommendations of “getting the basics right” by ensuring that young people achieve specified levels in functional mathematics, literacy and ICT, and were equipped with the knowledge and attributes needed to be successful in adult life, learning and employment. The report suggested achieving this by introducing an overarching qualification – the Diploma. Instead of having separate qualifications (GCSE's and Vocational GCSE's), each subject would be taught from level 1 to level 4 to work towards obtaining a Diploma. Tomlinson (2004) also suggested strengthening vocational routes and rationalising the curriculum where progression and the value of qualifications were clear. Instead, in 2005 the Labour government published their formal response in the White Paper 14-19 Education and Skills that rejected most of Tomlinson's ideas, despite these having strong professional support. The government outlined they would introduce 42 new Vocational Diplomas at various levels which would be separate to GCSE's (House of Commons, 2007), and in 2006 made it compulsory for pupils to achieve an A*- C in English and Mathematics for it to count towards the 5 A*- C measure for school league tables. It is important to highlight here that even though pupils needed an A*- C in English and Mathematics for it to count towards the school league tables, pupils do not necessarily need these grades to get into college if they are applying for a vocational course post-16 (DfE, 2025).

In 2015, the law changed to make it compulsory for young people to be in education or training until they were 18 as part of the *Education and Skills Act* 2008, as it was believed that it would lead to a more skilled workforce, better job prospects and reduce the chance of unemployment rates (DfE, 2024). This still applies today. If pupils do not achieve their English and Mathematics at a grade 4 or above at school, they have the opportunity to resit their GCSE mathematics or go onto study level 2 functional skills mathematics alongside their college course. However, this does limit the type and level of course they can apply for. Those who enter college without a pass at GCSE mathematics are not able to study A levels or vocational courses equivalent to a level 3, therefore those that do not achieve their GCSE mathematics at a grade 4 or above at school are limited to lower-level vocational courses.

In 2010, Michael Gove introduced the English Baccalaureate under the Coalition government (DfE, 2011) that was a step further away from Tomlinson's (2004) recommendations. The English Baccalaureate (EBacc) was introduced as a performance measure of academic studies. It had been noticed that there was an increase in pupils taking vocational courses, especially those from disadvantaged backgrounds. This meant that those pupils who took these courses could leave school with similar grades than those taking more academic subjects such as geography or a language, and still go on to further studies if they wished. However, with the introduction of the EBacc, it limited pupils' choice of subjects at GCSE level. To increase the uptake of academic subjects, pupils now had to take English, Mathematics, Science, History or Geography and a Language. Michael Gove, under the Conservative government, claimed that the EBacc was hugely increasing the uptake of core academic studies that were most valued by universities and employers, contradictory to the advice given by the Tomlinson Report (2004).

This policy decision not only limited pupils' subject choices but also negatively impacted educational outcomes, particularly for those who favoured vocational pathways or found traditional academic subjects challenging (Rogers and Spours, 2020). The introduction of the EBacc further narrowed opportunities for these pupils, signalling a return to the post-war prioritisation of academic disciplines aimed at cultivating a scientifically literate workforce in response to industrial and technological demands. However, by 2010, rapid technological advancements had already reshaped the labour market, with machines increasingly performing tasks that once required human mathematical proficiency (Gravemeijer *et al*, 2017). Coupled with growing concerns about widening attainment gaps (The Sutton Trust, 2016; 2024; Educational Policy Institute, 2024), this renewed emphasis on a rigidly academic curriculum appeared to undermine efforts to foster a more equitable education system, ultimately benefiting those already academically advantaged. Notably, these critiques originate from independent researchers and organisations unaffiliated with government. The impact of these changes is evident in the sharp decline in the percentage of pupils achieving five GCSEs at grades A*–C following the EBacc's introduction, falling from 81% in 2013, to 61% in 2014 (Rogers and Spours, 2020).

Furthermore, the General Secretary of the National Union of Teachers, Christine Blower, warned of a real danger that some young people will be directed away from subjects that would best support their developing aptitudes and ambitions (DfE, 2013). Vocational courses were mainly taken by those from the poorest backgrounds that have had a long history of stigmatisation; stereotyped as more suitable for those from working-class backgrounds and devalued. There have been attempts to upgrade vocational qualifications but have failed due to the middle classes not deeming it appropriate education for their own children. Instead, it is a failure of the education system to value and respect different types of knowledge that has caused a divide between vocational and academic knowledge (Reay, 2017). Alongside these issues, employers voiced their concerns that employees were unable to apply mathematical concepts to problems in the workplace (The Workplace and Training Foundation, 2014). They expressed their repeated concern that maths was being taught to pass an exam, rather than skills that could be transferred to the workplace (The Advisory Committee on Mathematics Education, 2011).

To consider the concerns expressed by employers, the new GCSE mathematics curriculum was introduced in 2015. This new curriculum aimed to consider these concerns by including more mathematical problem-solving scenarios by intertwining mathematical concepts together where pupils become fluent in the fundamentals of mathematics (DfE, 2021), but did not consider a change in the mathematical content that is taught. Again, despite Tomlinson (2004) advising that functional maths would serve the skills required in the workplace, the government have continued to favour the traditional academic route and instead masked the problem by introducing problem solving questions as a solution. This reform also seen the introduction of the new grade 9-1 system to provide greater differentiation between students, particularly those at the higher end of the attainment spectrum and consisted of more hours of teaching mathematics each week to compare to the teaching hours of those countries that outperformed the UK in their mathematical attainment levels (Ofqual, 2015; TIMMS, 2008). In 2019, the government announced its target to see 75% of pupils pursuing EBacc subjects by 2022 and 90% by 2025 (DfE, 2019). This ongoing emphasis on a traditional, academic approach is further reflected in how the current mathematics curriculum is officially described.

The current mathematics curriculum

The current mathematics curriculum is described as:

“a creative and interconnected discipline that has been developed over centuries, providing the solution to some of history’s most intriguing problems. It is essential to everyday life, science, technology and engineering and necessary for financial literacy and most forms of employment" (DfE, 2021).

The expectation is that majority of pupils' will move through the programme of study at the same pace and those who grasp concepts rapidly should be challenged, and those that are not fluent in earlier material should consolidate their understanding through additional practice before moving on (DfE, 2021). Within the description of the mathematics curriculum in England there is the acknowledgement that pupils need maths for everyday life and employment, and encourage those who excel to be challenged, with little regard to those that may struggle. Many teachers argue that the mathematics curriculum is overcrowded which does not allow for the repetition of topics depending on the pupils' rate of understanding, where a reduction in content would allow for sufficient time to enable all pupils to establish deep and lasting understandings of mathematical content (DfE, 2021; NCETM, 2024).

Key stage 1

The focus at key stage 1 is for pupils to develop confidence and mental fluency with whole numbers, counting, place value and measurement such as time, length, recognising shapes and money (DfE, 2021). There is an emphasis at this stage in using operations and working with numbers which forms the foundations for future learning and educational outcomes, where pupils also begin to develop their mathematical language (EEF, 2021c). From Key Stage 1, pupils begin to form attitudes towards mathematics, which can be either positive or negative depending on their early experiences (Dowker *et al*, 2012). Although research into younger pupils' mathematical attitudes remains limited (Dowker *et al*, 2012), studies by Gierl and Bisanz (1995) and National Numeracy (2023) suggest that these attitudes tend to become increasingly negative with age, often accompanied by rising levels of anxiety. It is important to recognise that at this developmental stage, much of children's learning is embedded in play-based activities (Chen and Eisenband-Sorkin, 2018; EEF, 2021c), which are typically associated with enjoyment and engagement.

Inequalities in mathematics attainment are evident from Key Stage 1, as shown by differences among pupils meeting the expected standard. At this early stage in a child's educational journey, disparities emerge across gender, ethnicity, free school meal eligibility, and region. Recent attainment data (DfE, 2023) reveal that between 2021 and 2022, performance declined across all measured characteristics. One of the most significant drops was amongst girls, whose attainment fell from 77% in 2021 to 67% in 2022 -1% lower than boys in the same year. A particularly large gap is seen between pupils eligible for free school meals (52%) and those not eligible (73%), indicating a 21% difference and highlighting the need for early support and intervention.

Ethnic disparities are also evident. Pupils of Chinese heritage had the highest attainment levels (88%), while Black-Caribbean pupils had the lowest (58%). White British pupils also ranked lower (68%), with similarly low attainment among Black-Caribbean and White mixed pupils (60%), suggesting a consistent pattern of inequality linked to ethnicity. Regional differences further compound these disparities, with North West England reporting the lowest proportion of pupils meeting expected standards in mathematics at just 66%.

Key stage 2

At key stage 2 the focus continues to be developing confidence with numbers, measurements and shapes by using numbers to add, divide, multiply and times, work out change and identify shapes, but begins to involve statistics to interpret tally charts, sorting and totalling data. The number topic develops to include fractions, and by the end of key stage 2, ratio and proportion and algebra is introduced to solve missing values and sequences. The change to include algebra and ratio and proportion at key stage 2 occurred in 2014 as part of the curriculum reform that was introduced to raise standards in mathematics and equip students with a stronger future in mathematical studies and more advanced work at secondary school (DfE, 2012). This was part of Michael Gove's incentive to raise standards, whilst at the same time there was growing concern over England's place in international league tables for their mathematical ability. Prior to 2014, there had been no introduction to algebra or ratio and proportion until key stage 3, but with this reform to improve mathematical ability, it increased difficulty levels at key stage 2. Macdonald (2014) argues that negative attitudes towards mathematics have been identified in pupils as young as 10 that are caused by maths anxiety, indicating a further negative impact on pupils educational outcomes.

At Key Stage 2, the same patterns of attainment gaps observed at Key Stage 1 persist (DfE, 2024g). Boys continue to outperform girls by 1%, and pupils eligible for free school meals remain significantly behind their non-free school meal peers, with attainment levels of 46% compared to 67%. Ethnic disparities also continue, with Chinese pupils maintaining the highest attainment (74%), while pupils of mixed White and Black Caribbean heritage (52%) and Black Caribbean pupils (53%) have the lowest. Regionally, the North West now ranks third lowest in attainment (60%), just above the South West, which has the lowest at 58%.

The consistency of these trends across two key stages spanning four year groups, demonstrates that such disparities emerge well before GCSE level, highlighting the urgent need for early intervention to prevent the deepening of educational inequalities. By the time pupils from disadvantaged backgrounds enter secondary school, many have already encountered significant barriers to learning and negative educational experiences. These challenges are not adequately addressed by the current curriculum framework outlined by the Department for Education (DfE, 2021), which appears to prioritise the advancement of already high-achieving pupils over the support of those who struggle. This suggests a systemic bias that favours fluency and performance over equity and inclusion.

Key stage 3

At key stage 3, this is where the preparation for GCSE mathematics begins and the focus shifts to develop fluency, reason mathematically and being competent in solving increasingly sophisticated problems and applying their mathematical knowledge in other subjects. There is more emphasis on algebra and geometry content. Those pupils that grasp concepts rapidly are to be challenged through more sophisticated problems before new content, and those that are not so fluent are yet again to consolidate their understanding of the content through additional practice (DfE, 2021).

Voderman *et al* (2011) identifies that at key stage 3, this if often where disengagement with mathematics occurs for those aged 11-14, where as many as half of those in the lower sets may be being taught by non-specialist maths teachers due to the shortage in teachers. This suggests that although maths anxiety and a dislike for the subject can be seen in pupils from key stage 1 (Macdonald, 2014), there is something at key stage 3 that exacerbates this engagement. This requires the need to understand what factors impact pupils' mathematical practices as there are no formal qualifications at the end of key stage 3 to compare attainment levels amongst different groups of pupils.

Key stage 4

At key stage 4, pupils should have been taught all the mathematical content of the curriculum, with additional content being taught to the more attaining pupils. There is no recognition of those pupils that are not so fluent (DfE, 2021). By the end of key stage 4 pupils sit their GCSE maths exam – either foundation or higher depending on their previous attainment levels. The highest grade possible for those that sit the foundation exam is a grade 5, with those than sit the higher exam is a 9. Voderman *et al* (2011) identifies that there is a 10-year learning gap between the highest and lowest achieving students amongst one cohort of students, where it is not possible for a such a diverse group of pupils to be tested from the same curriculum that is not fit for purpose. Attainment levels between groups of pupils at the end of key stage 4 will be discussed later in this chapter.

Not fit for purpose

In 2011, the Voderman report called for a curriculum review naming the maths curriculum at all levels not fit for purpose and suggested that most schools focus on teaching to the test due to league table pressures that are detriment to the child's mathematical education. A third of pupils in their first two years of secondary school make no improvement in their mathematical ability, which is at a point in the curriculum where there is more emphasis on abstract maths such as algebra and trigonometry and moves away from 'everyday maths'. Coincidently, this is also a stage which sees a high level of pupils disengage with maths. 90% of those that failed to reach their SATs target at key stage 2, then go on to fail GCSE maths (Voderman *et al*, 2011). This highlights a lack of support, understanding, and recognition for pupils who struggle with mathematics, a gap that is evident throughout curriculum documents. While these documents repeatedly urge struggling pupils to simply ‘keep practicing,’ they often provide ‘more challenging’ pathways for those who excel (DfE, 2021).

Functional Skills Mathematics

Functional skills maths is aimed at individuals that have left school and failed their GCSE mathematics. In colleges that offer vocational courses, it is often provided as an alternative qualification for students who did not achieve a passing grade in GCSE Mathematics. Upon completion, this qualification gains students access to further careers and study (DfE, 2024d). This suggests functional skills maths level 2 to be a solution to those students that struggle with GCSE mathematics, due to the focus on numeracy and maths needed for the workplace. Functional maths was also supported by Tomlinson (2004) that recommended for the government to offer this in schools as ‘core’ instead of GCSE mathematics as it better reflected the skills needed for the workplace. Despite this recommendation there has been no change.

Due to the opportunity for functional skills maths to gain pupils access to higher level college courses and careers, this does support Tomlinson (2004) position regarding the usefulness of mathematics. Without government support schools would be negatively impacted by this change, despite being for the good of the pupils that struggle with mathematics, due to this impacting their position in school league tables. School league tables impact on schools admission levels and funding (Burgess *et al*, 2020). This calls for an understanding in how pupils’ socio-cultural factors and value and relevance of the curriculum may impact mathematical practices to offer more nuanced solutions for pupils that struggle with mathematics.

Core maths

Core maths is a qualification for 16-19 year olds that do not go on to study A level mathematics, but have the opportunity to take core maths which focuses on applying mathematical concepts to real-world scenarios and developing skills in data analysis, financial literacy and problem solving (DfE, 2018). This was introduced as a response to the poor progression and uptake of A level mathematics from pupils aged 16.

Similar to functional skills maths, this qualification focuses on the real-world application of mathematics deemed relevant for everyday life and the workplace (DfE, 2018; DfE, 2024d). Due to this, there seems to be acknowledgement by the government of the difference between maths and everyday maths, where everyday maths seems to resonate more with pupils by the idea that more pupils will choose to take core maths instead of A level maths due to the relevancy of the subject. There is also an acknowledgement that workplace maths and maths are very different, indicating what is required by employers and what is taught at both GCSE and A levels mathematics is not needed for pupils to progress.

Although Functional skills maths and core maths offer a variation of the curriculum that focuses on the everyday maths for the workplace, these continue to be disregarded by government and schools as the maths that pupils should be learning. Instead, GCSE maths continues to be the subject that is required to be studied by all pupils and acts as a gatekeeper to further study and careers (National Numeracy, 2023). A switch between these ideas could begin to solve the issue of attainment levels, maths anxiety and maths confidence levels amongst pupils in England (National Numeracy, 2023) and highlights the importance of looking into the relevancy of the GCSE mathematics curriculum and how this impacts pupils' mathematical practices and England's position in international league tables.

The impact of the school and classroom

Each school has a different demographic make-up of pupils, as well as varying Ofsted ratings and positions in school league tables, all of which influence pupil admissions, funding, and access to resources (Drayton *et al*, 2023). The school a child attends is often decided by parents, usually based on catchment area criteria. Pupils living within this catchment area, determined by the local authority, are given priority in admissions to the school chosen by their parents (GOV, online; Hussain, 2016). As a result, schools in more affluent areas tend to have a higher concentration of pupils from middle-class backgrounds, whereas those in more deprived areas often serve larger numbers of pupils from working-class backgrounds, as measured by socio-economic status. The proportion of pupils eligible for free school meals, which research identifies as a key indicator of attainment levels (Campbell and Cooper, 2024; Francis-Devine *et al*, 2024), varies accordingly. Reay (2017) argues that pupils from different social backgrounds possess different forms of capital, which are not always valued equally within the education system. This leads to differences in school cultures shaped by each school's demographic make-up. Schools lower in league tables often have higher proportions of working-class pupils and develop distinct cultural norms and expectations as a result. Altogether, these factors suggest that the school a pupil attends, including its culture, resources, and intake, plays a significant role in shaping pupils' attainment levels and dispositions towards learning.

Within schools, pupils are typically placed into classes according to their academic ability, with those in the lower sets often being taught by a non-specialist teachers in mathematics (Voderman *et al*, 2011). Teacher shortages in mathematics remain a significant and ongoing challenge secondary schools in England. Despite government efforts to attract more graduates into teaching through incentives such as bursaries and training scholarships, recruitment targets for maths teachers have consistently been missed in recent years (DfE, 2023). As a result, many schools struggle to appoint specialist mathematics teachers, often relying on non-specialist teachers or temporary staff to fill gaps. This shortage can have a negative impact on pupils' learning, as specialist teachers possess deeper subject knowledge and stronger pedagogical skills to explain complex concepts effectively (Allen and Sims, 2018). When pupils are taught by non-specialist teachers, there is a greater risk of misconceptions, reduced engagement, and lower attainment, which can exacerbate existing inequalities and discourage pupils from pursuing mathematics at higher levels (Allen and Sims, 2018), highlighting the impact of the school and teacher on pupils' mathematical education.

The National Council of Teachers of Mathematics identify that pupil's understanding of mathematics and their beliefs about mathematics are shaped by the teaching encountered in school. They argue that teachers "exert a powerful influence on students'… and their mathematical disposition" (NCTM, 1989: 233). Furthermore, Birch and Ladd (1997) argue that teachers have the ability to emotionally connect with their pupils that may have an impact on their learning. Positive teacher and pupil relationships have been identified to have a positive impact on pupils' engagement and academic achievement (Birch and Ladd, 1997;

Attard, 2013). This suggests that the classroom dynamics including ability setting and the teacher suggests has the ability to impact pupil's mathematical dispositions and practices, therefore it is important to establish how these structures impact on pupil's mathematical practices.

Trends in Mathematics and Science Survey (TIMSS)

This section explores how international benchmarking, national policy goals, and socio-economic factors intersect to shape mathematics education in England. Drawing on data from the Trends in International Mathematics and Science Survey (TIMSS), it highlights how pupil performance is influenced not only by curriculum and teaching practices, but also by structural inequalities, particularly those related to socio-economic status, as evidenced by the persistent attainment gap between pupils eligible and not eligible for free school meals (FSM) (The Sutton Trust, 2016). In light of government ambitions to raise attainment and global competitiveness in mathematics, this section considers how performance pressures, league tables, and school funding incentives contribute to a system where middle-class values are reinforced, and educational inequalities are sustained.

Every four years, England and 64 other countries take part in the Trends in International Mathematics and Science Survey (TIMSS) which provides international comparable data on the performance and attitudes of Year 5 and Year 9 pupils in mathematics and science, alongside a comparison of the curriculum and teaching of the subjects. The TIMSS 2019 report indicates an improvement in mathematical ability in England, where more pupils are passing GCSE mathematics, but are constantly outperformed by Singapore and 4 other South-Asian countries (Mullis *et al*, 2020). The aim of the government is to increase the mathematical attainment of pupils, which they believe will better prepare pupils for further study and the 21st century workplace (NCETM: Online). Here, it should be added that attainment is important for schools as those that have the highest percentage of pupils achieving grade 9-4 in mathematics will move up in the league tables. League tables are where most parents look at first when deciding what school to send their child, which had led to competition amongst the middle classes to get their children into a school further up in the league table which has an impact on school admissions and funding (Allen and Burgess, 2011). The higher the number of pupils' that enrol at a school, the more funding a school receives, which can impact the schools access to resources and adequate teaching which the TIMSS report recognises (Mullis *et al*, 2020).

Due to an increase in mathematics attainment levels in England, there has been an 11.8% increase in the numbers of A levels mathematics entries in England (DfE, 2024e), achieving what Michael Gove set out to achieve that an increase in attainment would increase pupils' options to study maths post-16 (DfE, 2011). England's place in TIMSS international league tables has increased from 10th in 2015, to 8th in 2019 and back down to 9th in 2023. Mastery was introduced in 2014 as a response to being outperformed by China and Singapore in international league tables, however despite the introduction of this method inspired by East-Asian countries, attainment levels in England continue to be lower. When looking into detail, attainment gaps have widened (The Sutton Trust, 2016; 2024; DfE, 2021), so although more are achieving higher grades, those that are achieving lower are more disadvantaged. It is highlighted throughout the TIMSS report (Richardson *et al*, 2020) that those eligible for free school meals perform significantly lower than those who are not eligible for free school meals, and this gap is widening, especially since the COVID-19 pandemic (DfE, 2021).

Mastery

This section examines the introduction and evolution of the mastery approach in mathematics education within the UK, particularly following recent curriculum reforms. It explores how the concept of mastery, though historically rooted in Bloom's (1968) work on formative assessment and inclusive pedagogy, has been reshaped through international comparisons and political influence, most notably through references to high-performing East Asian education systems. As mastery has gained prominence in UK educational policy, particularly under the leadership of Nick Gibb, its meaning and implementation have become increasingly complex and contested (Drury, 2018; NCETM 2024a).

The focus on mastery was introduced to the education system shortly after the curriculum reform in 2014. The term 'mastery' has been used over time in education to refer to a range of pedagogical and curriculum approaches to learning. In the UK, the term mastery is historically associated with Bloom (1968) who identifies that pupils achieve mastery by the use of regular formative assessment and the idea that everyone can succeed, except those with cognitive disabilities (Guskey, 1997). However, since Nick Gibb's role as Schools minister and the introduction of the Trends in Mathematics and Science Survey (TIMSS), the term 'mastery' is now more widely associated with the Asian interpretation and methods of teaching Mathematics (DfE, 2016). It has the same criteria which Bloom (1968) set out (frequent formative assessment and the belief that everyone can achieve), but differs to include carefully designed lessons using models, problems and practice materials, and whole-class interactive teaching with pupils of all abilities learning alongside each other (Boylan *et al*, 2019).

The Programme for International Student Assessment (PISA) is a worldwide study by the Organisation for Economic Co-operation and Development (OECD) which evaluates educational systems by measuring 15-year-olds performance in Mathematics, Science and reading. PISA in 2012, found that East Asian countries are up to three years ahead of UK pupils in the mathematics ability by the age of 15 (OECD, 2012). Nick Gibb (Schools minister under the Conservative and Liberal Democrat coalition government) spoke at the Advisory Committee of Mathematics Education (ACME) conference in July 2012 on the current mathematic climate in the UK (DfE, 2012). Firstly, he identified that maths is largely presented as a subject pupils take to simply gain employment or pass an exam. Gibb highlights that we should move away from this view, but contradicts this later in his speech to acknowledge that it is a basic requirement for many employers, therefore those who have not achieved an A* to C grade in GCSE maths should study to achieve this by the age of 18. He also identifies the difference in achieving these grades depending on the school which pupils attend. In 2012, a total of 1.7% of pupils achieved an A* in mathematics with this figure being close to zero for those that attend state schools (The Sutton Trust Report, 2012). Gibb also addressed issues that only 58% of those eligible for free school meals achieve their expected levels at English and Maths, compared with 78% of all other pupils (DfE, 2012). The issue of attainment levels between those eligible and not eligible for free school meals, continues to be highlighted across international reports.

Gibb recognised that ambition, autonomy and opportunity are the hallmarks of every high performing education system in the world, where the highest educational attainment in expected of all pupils. He continued to highlight that the South Asian mastery method of teaching mathematics can add to our society to increase mathematical attainment levels in the UK (DfE, 2012). This led to the creation of the Mathematics Teacher Exchange programme. In 2014, 60 teachers from 45 English primary schools visited Shanghai schools, in exchange 59 mathematics teachers from China visited 48 English primary schools to model mastery teaching. Although Shanghai topped the PISA leader boards in Mathematics at this time, this exchange was related to wider trade negotiations between England and China (Boylan *et al*, 2019). This highlights the wider political impact on education reforms and policies, and especially mastery; whether the mastery method was implemented to increase mathematical attainment levels in England, or implemented as part of a trade deal for political gain (GOV, 2018). The English primary schools that were involved in this exchange programme became leaders in sharing their knowledge with other schools in England.

In 2016, Nick Gibb announced that 8000 primary schools in England would receive £41 million over four years to support the maths mastery approach. This led to the creation of 40 maths hubs around the UK to offer Continuing Professional Development (CPD) sessions to teachers to train them to implement this method into their classrooms. In 2018 this also expanded to Secondary Schools however, there was not, and still does not seem to be a consensus of what the mastery method involves, especially in secondary schools (Drury, 2018; NCTEM (2024b). Mastery is a slippery term which can be used in many different ways (Boylan *et al*, 2019). There are many different programmes that use the term 'mastery', but offer different methods and resources of teaching, many of which do come from Shanghai and Singapore, but have their roots in historical concepts teachers are already familiar with.

The overseas influence of the education system, in particular mathematics, is not new. The recommendation of a daily oral or mental starter activity was informed by practices in Taiwan and whole-class plenaries were influenced by East Asia, both which are still used today (Boylan *et al*, 2017). However, the extent to which these practices are fully implemented is contentious (Smith *et al*, 2004). Prior to the mastery method, two innovations informed by Singapore were introduced in England: *Maths No Problem* in 2007 and *Ark Multi-Academy Trust*. *Maths No Problem* were translations of Singapore textbooks for Primary schools, where *Ark* began to develop an in-depth curriculum by Helen Drury, a former Secondary Mathematics teacher and now government advisor, where the term mastery was first used in relation to mathematics (Boylan *et al*, 2019).

According to government guidelines, there are elements of the mastery method such as whole class interaction, frequent formative assessment, the use of models; such as the bar model and concrete, pictorial and abstract (CPA) representations in Mathematics to develop a deeper understanding and mastery of maths, and the concept that pupils are not put into sets according to their ability, but instead are all taught together with the same materials, (Boylan *et al*, 2019). Even with these guidelines it has created a lot of flexibility in the way mastery is implemented across different schools and organisations. For example, Helen Drury in her book '*Teaching for Mastery*' explains teaching for Mastery is 'to teach with the highest expectations for every learner, so that their understanding is deepened, with the aim that they will be able to solve non-standard problems in unfamiliar contexts', (Drury, 2018: 14).The National Centre in Excellence for Teaching Mathematics (NCETM) who are funded by the government to carry out this training for schools see it as 'elements of classroom practice and school organisation that combine to give pupils the best chances of mastering maths. Achieving mastery means acquiring a solid enough understanding of the maths that's being taught to move onto more advanced material' (NCETM: Online). Here, it is evident that there are different interpretations of what mastery is, with it not being a requirement for schools around the UK to use the mastery method. This links back to Smith *et al* (2004) that identified that the extent to which these practices are implemented in the UK are contentious, whereas in East Asia it is general practice and knowledge, suggesting cultural differences how this method is implemented. The further highlights that the socio-cultural context of learning mathematics matters.

Challenges of the Mastery Method and the Education System

The Longitudinal Evaluation of the Mathematics Teacher Exchange (2019) Report has identified that Asian mastery teaching is the product of educational and cultural norms: the expectation that all pupils will learn, parental, pupil and teacher culture of high expectations, independent study, the belief that ability is malleable rather than fixed, with the high level of involvement of both parents and grandparents in supporting their child's school learning. Additionally, a key element of the pedagogy of mastery in East Asia is that homework is set daily to identify any gaps where intervention is immediately given. Here, it can be suggested that there are many differences between East Asia and England in terms of educational expectations and cultural norms. The emphasis on high level of parental involvement needed for the mastery method to be successful in increasing pupils' mathematical attainment is something that is seen as an issue, with low parental engagement consistently reported and seen as an issue in England (The Sutton Trust, 2017; EEF, 2025). Due to these socio-cultural differences, Boylan *et al* (2019) identified that there are many other factors that contribute to pupils' mathematical attainment, and that the mastery method had not had a significant impact on increasing attainment so far. Therefore, this thesis aims to understand how pupils' socio-cultural factors impact mathematical *habitus* and practices.

In addition, in East Asia, maths activities and resources are developed with university researchers and informed by teacher research (NCSL, 2013, 2014). This differs to England where the National Curriculum is informed by the government, which often goes against the advice of researchers and working groups set up to address inequalities in education (Tomlins, 2004; Voderman *et al,* 2011). Robinson (2022) argues that since the industrial revolution governments have taken a keen interest in education as they know that an educated workforce is essential to creating economic prosperity. However, since then the world of work has changed profoundly and continues to do so at an every-quickening pace, however the same subjects are being taught in schools with the emphasis on academic subjects (Robinson, 2022). Robinson (2022) further argues that the education system no longer serves society and puts forward a holistic approach to education, similar to that of Tomlinson (2004), where pupils focus on disciplines according to their interests which merge subjects and collaborate with each other.

Throughout history, there has been an attempt to reform the mathematics curriculum and the education system, but instead the government have always favoured academic subjects despite the knowledge and recommendations of the positive impact vocational studies and curriculum reform can have on society, employers, those pupils from the poorest backgrounds (Tomlinson, 2004; Voderman *et al*, 2011; Robinson, 2022). Reay (2017) argues that it is unsurprising that socioeconomic gaps widen as a child progresses through school as it implies that schools exacerbate rather than mitigate social class inequalities in attainment outcomes, especially as the education system lacks curriculum activities that draws on the strengths and uphold the value of their working-class cultures. Instead, the emphasis on academic subjects continues, and the pre-requisite to obtain a grade 4 or above in mathematics to gain access to employment and further study (National Numeracy, 2023), where success in this depends on the acquirement of social and cultural capital which the education system favours (Bourdieu, 1984).

Mastery today

According to the NCTEM (2024b) 'mastery mathematics' is still being used across secondary schools in the UK, however the extent of how this is being implemented is unknown. By 2023 the aim was for 50% of secondary schools to engage with the teaching for mastery support provided through the Maths Hub Network (Maths Hub Network, 2023), with recent figures showing that by 2024 49% of secondary schools were actively engaging with the programme (NCETM, 2024b). This suggests that schools are increasingly being involved with mastery teaching, but how this is then implemented in schools is unknown. The EEF (2021) recognise that many studies regarding the evaluation of the mastery method are often difficult due to the variation in the implementation of mastery across schools, and the different approaches taken inspired by a variety of different methods including Ark Mastery, Maths No Problem and the NCETM, alongside schools' own interpretation.

Although since 2007 England has continued to increase its attainment levels amongst international league tables, there have not been any significant increases since the implementation of mastery in 2016 (DfE, 2024e), suggesting little impact on mastery in raising attainment levels and the need to focus on the socio-cultural experiences of pupils. The cultural context of England must be considered. We live in a society where being bad at maths is seen as a badge of honour, where it is ok to be bad at maths and is something that is culturally acceptable (Sharp, 2017; Kowsun, 2008 cited in National Numeracy, 2023), especially in a country that has a strong non-STEM identity (Nuffield Foundation, 2010).

Critical Mathematics Education

This section situates mathematics education within broader sociological debates about class, power, and the reproduction of inequality, that is often referred to critical mathematics. Critical mathematics is concerned with the reproduction of inequalities that may be established by factors outside of education but reinforced by educational practice, power relations and the need for educational practice to be understood (Skovsmose and Neilson, 1996). Drawing on Bourdieu's Theory of Practice (1977), it explores how social class shapes students' dispositions (*habitus*), access to valued resources (capital), and navigation of the educational system (field), particularly within the subject of mathematics. Mathematics is often framed as a meritocratic subject, yet it plays a central role in stratifying pupils and legitimising unequal outcomes (Louie, 2017).

Bowles (1971) argues that unequal education has its roots in the class structure which serves to legitimise and reproduce inequalities for the functioning of a capitalist society. Traditionally, education was only for those of the social elite, and once education became available to everyone, those from working class backgrounds tended to leave school earlier to fulfil jobs in factories. Positions in the social division of labour came to be associated with educational qualifications, reflecting the number of years and quality of schooling (Bowles, 1971). This use of qualifications reflect society today where mathematics is used as a gateway to further education and specific careers (National Numeracy, 2023). Those 'higher level' courses such as A level mathematics require higher grades in GCSE mathematics to gain access, with a higher percentage of those from advantaged backgrounds taking courses such as A level mathematics than their disadvantaged peers (Wakeling, 2024). This coincides with Bowles (1971) that recognised those pupils' that finished school and gained qualifications tended to be those from the social elite, which gave them entry into further education and higher managerial positions, indicating no development over the years.

This aligns with Sugarman's (1970) concept of immediate and deferred gratification, which further illustrates how working-class pupils are socialised to prioritise immediate entry into the workplace rather than pursuing long-term educational goals that might enable social mobility. Together, these perspectives highlight the powerful influence of socio-cultural factors on educational journeys, and the need to explore this further in regards to its impact on educational practices and outcomes.

Critical Mathematics Education focuses on the socio-political role of mathematics in maintaining inequality. Historically, education was reserved for the elite, and when it became accessible to all, the same curriculum designed for the elite was extended to everyone, without considering the diverse needs or socio-cultural backgrounds of all students (Bowles, 1971). This has resulted in a curriculum heavily shaped by middle-class values (Ingram and Abrahams, 2016; Bourdieu and Wacquant, 1992), where mathematics serves as a form of cultural domination, reinforcing middle-class norms and practices. Consequently, students who do not possess the same cultural capital are more likely to underachieve. This cultural dominance remains largely unchallenged, as it plays a crucial role in maintaining social inequalities (Ball, 2010; Reay, 2017; Shain, 2016, cited in Nightingale, 2018). Although there have been some efforts to address these disparities, for example, through initiatives aimed at closing attainment gaps and expanding vocational education under *The Learning and Skills Act* 2000 to better align with labour market needs (Bartlett, 2009; Tomlinson, 2004), these measures often reinforce existing hierarchies. By dividing students into those considered suited or unsuited to academic subjects, the system maintains educational inequalities and reproduces social divisions. Reay (2017) further notes that middle-class families generally reject vocational pathways for their children, viewing them as inferior, thus deepening this educational stratification.

Jurdak *et al*, (2016) argues that contemporary school mathematics education is designed to integrate pupils into and legitimise the existing social order. The dominant narrative that success in society depends on obtaining a pass in GCSE mathematics, reinforced by a fear of failure, serves to sustain and deepen educational inequalities. Pupils are repeatedly told about the essential role of mathematics in everyday life, a message that Jurdak *et al*, (2016) critiques as an ideological illusion. This is further evidenced by the government's recognition of alternative qualifications, such as Functional Skills Mathematics, which adopt a different curriculum more directly focused on everyday life and workforce skills (DfE, 2024d).

Moreover, Pais (2013) highlights that although teachers and others within the education system are aware of these inequalities, the ideology encourages them to ignore or deny what they see. The constant assertion that mathematics is needed, both as a requirement for employment and further education, discourages critical questioning and leads to widespread acceptance of its role. Dowling (1998) supports this, arguing that mathematics serves as a powerful tool for reproducing social differences and maintaining power structures. Pupils who internalise the message that mathematics is essential, often reinforced by parental support, are more likely to succeed. In contrast, those who receive conflicting messages at home may disengage and underperform, reinforcing existing social inequalities (Dowling, 1998).

This demonstrates how mathematics education contributes to the maintenance of social hierarchies and highlights the need to critically examine the curriculum's value and relevance. It also highlights the importance of considering how socio-cultural factors, shaped by one’s position within the social structure, influence pupils’ educational journeys and outcomes. These ideas resonate with Bourdieu’s theory of practice (1977), which emphasises the role of different forms of capital in shaping practice, and align with Boylan *et al*’s (2019) call to understand the social and cultural contexts that impact educational outcomes.

Theoretical Framework

The theoretical framework for this research draws on Bourdieu's Theory of Practice (1977) to explore the social and cultural factors that influence *Mathematical Habitus* and practices. Central to his framework are the interconnected concepts of *habitus*, capital, field and practice[1], which together offer a lens through which to understand how educational inequalities are reproduced. In particular, Bourdieu's formula "(*habitus* x capital) + field = practice" (1977: 101) provides a conceptual structure for analysing how individuals' dispositions and access to resources interact to shape mathematical practices and outcomes.

Whilst emphasis is placed on *habitus* in this research, it recognises that *habitus*, capital, field and practice are deeply interdependent and must not be considered in isolation. Instead, they are used collectively to provide a quantitative measure of *Mathematical Habitus* that operationalises these concepts to investigate how they can impact pupils' mathematical practices.

Bourdieu and Education

Bourdieu's research is widely influential within the sociology of education to better understand the inequalities within the education system from primary, secondary, further and higher education into employment (Reay 2004, 2017, 2020; Ingram, 2009, 2011; Friedman *et al*, 2015, 2016). For Bourdieu, the key purpose of education is its reproduction of social inequalities. He emphasises the importance of identifying how the school system contributes to reproducing the unequal distribution of cultural capital, that through it, reproduces the social structure (Bourdieu and Passeron, 1990). Bourdieu argues that education functions as a relational structure shaped by differences in an individuals' position in society that is determined by the unequal distribution of capital. This structure reproduces inequalities which he describes as happening 'behind the backs' of those involved. Teachers, pupils and parents all play a role in legitimising and sustaining these power imbalances, helping to transmit cultural capital across generations (Bourdieu and Passeron, 1990; Liu, 2018). The education system contributes to reproducing inequalities by disguising and thereby legitimising inequalities of

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1Will be discussed in more detail on pages 65-78 power and privilege. This occurs more subtly through the unequal allocation of credentials amongst pupils and the continual re-distribution of those who possess inherited middle-class capital. Additionally, it is reinforced through the use of symbolic violence, which marginalises individuals within the education system by privileging cultural norms and values aligned with certain class, gender, and ethnic characteristics. Bourdieu goes on to argue that the education system is dependent on the structure of middle-class values (Bourdieu and Passeron, 1990).

Due to Bourdieu's interest in how the education system reproduces inequalities, many argue that Bourdieu's concepts are too deterministic. They argue that his concepts do not offer an explanation of how pupils within the same classifications can have different educational outcomes and have any agency of their own actions (Jenkins, 1982; Inglis, 2013; Peters, 2014). However, Bourdieu (1990) acknowledges this misinterpretation of his work due to the translation and the removal of empirical evidence in his books, and in his work towards a reflexive sociology (Bourdieu and Wacquant, 1992). This work offers explanations how *habitus* is not fixed, and is neither a result of free will or determined by structures, but created by the interplay of the two over time where dispositions that are shaped by previous events and structures shape current practices (Bourdieu, 1984). As he explains:

"[T]here is no rule ... that can provide for all the possible conditions of its execution, and which does not, therefore, inevitably leave some degree of play" (Bourdieu, 2000: 161).

However, it is suggested here that Bourdieu recognises that these changes are minimal due to the power the education system has to exclude those that do not display the same dominant norms and values towards education, and in return does not generate credentials for those individuals. This emphasises the importance of using Bourdieu's concepts to better understand the influences on pupils' educational practices.

Habitus

Habitus is a set of dispositions, that are influenced by an individual's place in the social system and has its roots in family upbringing. *Habitus* is described by Bourdieu as "a system of lasting, transposable dispositions which, integrating past experience, function at every moment as a matrix of perceptions, appreciations and actions and makes possible the achievement of infinitely diversified tasks" (Bourdieu 1977: 82). The primary socialisation and surrounding environment of the individual creates a schema of how that individual sees the world, which influences how a person behaves related to their previous experiences (Edgerton and Roberts, 2014; Kennedy, 2012). Bourdieu (1977) explains this as "a subjective but not individual system of internalised structures, schemes of perception, conception, and action common to all members of the same group or class" (Bourdieu 1977: 86), with him later emphasising the relationship between *habitus* and practices though his formula '(*Habitus* x capital) + field = practice' (Bourdieu 1977: 101). Here, Bourdieu recognises the complexity of *habitus* being influenced by cultural capital and the field in which it is contained. Due to these different influences, *habitus* is often associated with cultural background, home environment and socio-economic status (Raymond 1997 cited in Kennedy, 2012), that influences the way they navigate the social world (Swartz, 1997). Bourdieu and Passeron (1990) identify that the family and the education system are the two most influential forces, followed by the environment and peer groups on *habitus.* He identifies that the individual, family, school and neighbourhood are embedded subsystems of a larger social system, whereby each subsystem influences and is influenced by the others (Kennedy, 2012).

There are two main aspects of *habitus* that are important to discuss. The first is that *habitus* is embodied, and the second that *habitus* is a relational concept that is evident in his theory of practice formula (Bourdieu, 1977:101). The idea that *habitus* is embodied is highlighted in Bourdieu's (1984) idea of the 'feel for the game', for what people believe to be acceptable and valued, or legitimate according to their primary socialisation that becomes an embodied social structure. This embodiment operates at a preconscious level that manifests in our preferences, attitudes and inclinations. The embodiment of *habitus* and capital are closely related. Embodied capital can become embedded into our *habitus* as dispositions that can influence our practices (Bourdieu, 1977; Edgerton and Roberts, 2014).

This links with the idea that *habitus* is a relational concept as our interpretations of the social world are determined to a great extent by the capital individuals possess

(Bourdieu, 1991). Kennedy (2012) draws on the example of the classroom where an individual's capital is manifested as acquired knowledge and skills, that influences practices within the classroom, which if align with the middle-class values of education are valued. Therefore, an individual's attitude is a result of the way they perceive and interpret the field of education, due to the influences of the capital they have acquired, and their dispositions are the internalised schema that guides behaviour. *Habitus* must be seen as always in a process of reconstruction as it can be modified as we are faced with new experiences that do not match our pre-existing dispositions (Kennedy, 2012).

Reflexive *Habitus*

There is much debate that *habitus* is a deterministic construct (Jenkins, 1982; Inglis, 2013; Peters, 2014), however Bourdieu (1977) recognises that *habitus* is not deterministic or rigid by explaining:

> "the *habitus* acquired in the family underlies the structuring of school experiences (in particular the reception and assimilation of the specifically pedagogic message), and the *habitus* transformed by schooling, itself diversified, in turn underlies the structuring of all subsequent experiences (e.g. the reception and assimilation of the messages of the culture industry or work experiences), and so on, from restructuring to restructuring" (Bourdieu 1977: 87).

Here Bourdieu acknowledges that *habitus* can be changed by the education system with people coming together from different backgrounds with different views and practices. Later, Bourdieu and Wacquant (1992) developed the idea of reflexivity, that '*Habitus* is an open system of dispositions that is constantly subjected to experiences and therefore constantly affected by them in a way that either reinforces or modifies its structures (Bourdieu and Waquant, 1992: 133)'. There will be pupils where their capital and *habitus* does not align with that of the education system, therefore the *habitus* becomes disjunctive (Ingram and Abrahams, 2016). Bourdieu's (2000) later term, counter training, is useful in explaining the possibility of change in one's *habitus* due to repeated exercises over time and space especially within education. Within education, children spend more of their awake hours at school than they do at home, therefore it is important to consider how the influences of the child's environment at school can create a change in the *habitus*.

When an individual encounters an unfamiliar field, *habitus* is transformed (Bourdieu, 1990b). The *habitus* become disjunctive where an individual's set of dispositions clashes with the rules and expectations of the social field, which presents an opportunity for transformation (Ingram and Abrahams, 2016). For example, those from a working-class background may have different cultural values of education than those from middle-class backgrounds, which the education system prioritises as it is often associated with increased attainment and them knowing the 'feel for the game' (Bourdieu, 1984; Reay, 2017). Therefore, over time it is possible that a child's cultural values can change depending on those around them as we are constantly influenced by our surroundings (Bourdieu, 1990). However, the impact of education to change cultural values to align with that which school prioritises, can be made difficult due to the structure of the education system to set children according to their academic ability. The Department of Education (2013) identify that there is a higher proportion of pupils that are eligible for free school meals that are in the bottom sets compared to a higher percentage of those who are not eligible for free school meals in the higher sets, with cultural values being one of the most influential factors on mathematics practice over their natural ability (Ofsted, 2021). Therefore, if pupils are not exposed to people who have different socio-cultural differences to themselves, this can reconfirm their *habitus* that limits change (Ingram and Abraham, 2016). Egerton and Roberts (2014) identify it is the *habitus*-field congruence that plays a major part in this. If the dispositions align well with a particular field, change is unlikely or minimal, whereas if dispositions align less well, then some degree of disruption is inevitable which will create an adjustment in the *habitus*. For example, the middle-class student who exhibits the dispositions that align with school standards and expectations, are likely to experience a level of academic success that reinforces their school-positive *habitus* and probability of them continuing onto higher education. Whereas the working-class student that does not have the capital and dispositions that align with the school standards are more likely to express negative attitudes towards school and experience less academic success (Edgerton and Roberts, 2014). This is not to put blame on those from working class backgrounds, but to identify how the education system favour those pupils with middle class values that creates inequalities within the education system. However, Edgerton and Roberts (2014) also identify that there are also working-class students that overcome this barrier and do well academically. They regard that these pupils are from working class backgrounds that have done well academically from an early age and due to this, see school in a positive light and opportunity for social mobility, which indicates a change in the value of education. School is regarded as a child's secondary socialisation (Giddens and Sutton, 2021), which highlights the impact school can have on pupils' dispositions towards education. This increased social capital positively alters the pupils' aspirations towards school (*habitus*) which in turn increases their academic practices as their values starts to align with that which the education system favours (Costa and Murphy, 2015). Kennedy (2012) identifies that school encourages changes in individual's practice to that of the middle-class culture which it favours, that will be discussed in more detail in the next section.

Disjuncture in the *habitus*

Bourdieu (2000) acknowledges changes in the *habitus* through his concept of the cleft *habitus*. The cleft *habitus* is referred to as a change in *habitus* that differs from the family *habitus*, and when disjuncture occurs between what someone is familiar with and a new environment they experience, that person can be made to feel out of place. Children are forced into new spaces by compulsory education that creates a new lens for them to look through that can be a very different environment than what some pupils are familiar with. Bourdieu (2002, cited in Ingram and Abrahams 2016) talks about the idea of dialectical confrontation between the *habitus* and field that occurs when dispositions encounter conditions, including fields, that are different from those where they were constructed. Ingram and Abrahams (2016) further explore how the cleft *habitus* (Bourdieu, 2000) can lead to greater reflexivity and different outcomes for children within the education system.

The idea of reflexivity presents itself in Bourdieu's later work (Bourdieu and Wacquant, 1992; Bourdieu, 2000). Bourdieu uses radical examples to explain the cleft *habitus*, however it fits well within the field of education where many children are confronted to the field of education which they are not attuned. The cleft *habitus* can lead to conflicting dispositions and a *habitus* tug (Ingram, 2011) where an individual can feel pulled in different directions. Lahire (2011 cited in Ingram and Abrahams (2016:146) argues that 'compulsory education leads children to be faced with forms of cultural apprenticeship, knowledge and social relations that are quite foreign to their original milieu'. Kennedy (2012) acknowledges that *habitus* acquired in the family can be restructured by school experiences and if school experiences are repetitive, *habitus* can grow more rigid determined by beliefs commonly shared by the school culture. Therefore, the reflexive *habitus* depends on the field, and capital one already has. Here, the concept of counter training is useful to explain changes of *habitus* within the field of education as a key aspect of counter training is the idea of repetition over time and space (Bourdieu, 2000). Children spend more of the time they are awake in school than their own home, so although the cleft *habitus* gives us an explanation of how changes can occur within *habitus*, there is little acknowledgement to what influences these changes other than the overarching idea of capital and field.

Ingram and Abrahams (2016) provide a typology for four key *habitus* interruptions. These interruptions provide a blueprint to understand how changes in the *habitus* can be made within the field of education by acknowledging the impact of the home and school environment.

- Abandoned *habitus* –This is where a person renegotiates their *habitus* in response to a new field and over a period of time the new field becomes dominant as part of the *habitus* in response to structuring forces. For example, working class students may adopt attitudes of their middle-class peers that makes them behave appropriately and perform well within school, but are then less attuned to the appropriate ways of being when at home.
- Re-confirmed *habitus* – This is where a new field is rejected so the *habitus* is not changed. Ingram and Abraham believe this can be conscious and unconscious and refers to Willis (1977) working class lads that rejected school. Bourdieu (1992) also refers to Willis (1977) idea of resistance where the working-class lads cling on to their masculinity as something they are familiar with that traps them into their social position. Ingram and Abrahams

(2016) recognise that schools purvey middle class values that creates resistance for working class kids.

- Reconciled *habitus* – This is where pupils can navigate both fields (home and school) by drawing on different aspects of their *habitus* depending on what field they are in. Bourdieu explain this to be the 'feel for each game' (Bourdieu, 1984) that requires a high degree of reflexivity.
- Destabilized *habitus* – This is where pupils try to navigate both fields (home and school) but cannot achieve successful assimilation of either that results in conflict and division and a feeling of not fitting in anywhere.

Although not one of their four typologies, Ingram and Abrahams (2016) speak about the confirmed *habitus* of those students that are not exposed to a new field, and where their capital and *habitus* is confirmed on a daily basis. These are the students with middle class values already, which Bourdieu (Bourdieu and Wacquant, 1992) refer to as 'fish in water' where they take the world around them for granted and norms and values are confirmed each day within the field of education.

Ingram and Abraham (2016) acknowledge that there has been little discussion how some working-class children accept the so-called middle-class values. Reay (2004) refers to the 'habitual' use of *habitus*, where people focus on *habitus* and little on capital and field, where in the equation (*habitus* x capital) + field = practice (Bourdieu 1977:101) they must be used together. This research takes inspiration from Ingram and Abraham's (2016) typologies as an acknowledgement of the impact the family and school can have on the *habitus* depending on an individual's previous experiences. This research uses these concepts to develop the Harris Dispositional Framework to understand how social and cultural capital, alongside demographic factors, peers, parents, teachers and school impacts *Mathematical Habitus*.

Capital

Capital is acquired from childhood by the family and is relational to the family's social class background that influences the way a child experiences the world, their perceptions, norms and values, and the resources they have to navigate through society (Bourdieu, 1986). There are three main forms of capital: economic, social, and cultural. This research will focus specifically on social and cultural capital, following the recommendations of Boylan *et al* (2019). Their work highlights that the high levels of mathematical attainment in China are strongly influenced by cultural norms and a shared culture of high expectations amongst parents, pupils, and teachers. A key factor in this success is the active involvement of both parents and grandparents in supporting children's learning at home and in school. Bourdieu (1986) refers to social capital as having membership of a group, in which the group provides its members a collective capital (shared norms and values) that entitles them to credit to navigate through a variety of social spaces. These groups can be family, social class, school etc that by being a part of gains an individual credit that may be practical, material, and/or symbolic that is exchanged within social settings to maintain the group's status quo. The amount of social capital an individual has depends on the size of their networks, with a larger network making it easier to navigate various spaces due to the increased amount of social capital they have. However, social capital is never completely independent and derives from cultural and economic capital.

Cultural capital has dominated educational research (Lareau and Weininger 2003; Sullivan, 2001; Reay, 2004). Bourdieu refers to cultural capital firstly as a theoretical hypothesis used to explain the unequal academic achievement of children from different social classes, with this developing into a concept explained as the familiarity with the dominant culture in a society that can only be produced by family upbringing (Bourdieu, 1986). Bourdieu (1977) explains there are three types of cultural capital: embodied, objectified and institutionalised. Embodied capital is capital that creates long lasting dispositions in the mind and body, objectified capital is the possession of cultural goods such as books, instruments, machines, and institutionalised capital is qualifications that symbolise cultural competence and authority (Bourdieu, 1986). The volume and type of capital one has can determine an individual's position in the social structure. Here it is evident that capital is not a straightforward concept as Bourdieu hints at a complex system of capitals which is dependent on a multitude of factors and the field in which they exist.

Bourdieu recognises that the education system assumes that everyone has possession of the same capital due to the way it is organised. Back in the 1800's, more children from upper class backgrounds went to private school and more children from working class backgrounds went to state schools, as many of them had to work to provide an income for their family (UK Parliament, 2014). This changed gradually from 1880 as school became compulsory for everyone until the age of 10, and through to *The Education Act* 1944 that ensured free secondary education for all pupils until the age of 15, with future provision for it to be raised to 16 (UK Parliament, 2024). From here, working class pupils were expected to inherit the norms and values of the middle class, legitimised by adhering to these rules in return for credentials. Instead, this put working class students at a disadvantage and legitimised this dominant culture of the middle class through its use of qualifications (Bourdieu and Passeron, 1990). Bourdieu refers to this as symbolic violence, with an unconscious reinforcement of the status quo which is seen as the norm to those who are within the education system (Bourdieu and Passeron, 1990). Qualifications are 'sold' to students as an opportunity for social mobility (National Numeracy, 2023). Here you can see the intertwining of embodied, objectified and institutionalised cultural capital to help navigate through the field of education. Those that have the capital from their family, the expectations, familiarity and 'rule of the game' (Bourdieu, 1984, Bourdieu, 1986, Lareau, 2003) engage more successfully with school that helps them gain these qualifications and justifies the inequality between educational success and class.

Measuring cultural capital today

It must be acknowledged that at the time of Bourdieu's writing, cultural capital could be measured very differently than it can today. Cultural capital has been widely measured by the amount of books someone owns, visits to art galleries and type of music listened to (DiMaggio, 1982; Sullivan, 2001; Jaeger, 2011; Sieben and Lechner, 2019) that has derived from Bourdieu's (1986) idea of the objectified cultural capital. By having these goods and experiences enabled individuals to navigate more of the social world and be more socially mobile. Nowadays, the same competencies do not apply and instead the objectified cultural capital is more about the leisure activities, eating habits and holiday preferences of individuals, that is closely linked to economic capital and disposable income (Savage *et al*, 2013). Furthermore, Prieur *et al* (2023) identify how with the aging term of cultural capital and generational changes in society, Bourdieu's (1986) concepts still apply but have changed. A better way of understanding the impact of objectified capital today is by understanding the restricted role of classical culture, the appeal of popular culture, digital technology, and moral-political positions as markers of how the measurement of these terms have changed (Savage *et al*, 2013).

Cultural capital is known for its difficultly to measure (Burke, 2016) but is a term that is widely used by educational researchers and practitioners to explain differences in attainment (Sullivan 2001; Ofsted 2023; The Sutton Trust, 2024). More recently in 2019, Ofsted introduced the term into their framework despite being acknowledged for its subjectiveness, which they define as ‘essential knowledge that pupils need to be educated citizens’ (Ofsted, 2019a: 10). Chief inspector Amanda Spielman later explained in her speech that ‘it’s about being able to learn about and name things that are, for many, outside their daily experience’ (Ofsted, 2019b). This is problematic as it is acknowledging the elitist culture within education and that in order to be successful, pupils must inherit these forms of capital that are deemed favourable by the education system, despite it being outside of most children’s norms. This supports Bourdieu’s writings of the education favouring middle class values (Bourdieu and Wacquant, 1992). This research focuses on a range of capitals and their interplay between *habitus*, capital and field to inform mathematical practices.

Science and Mathematics Capital

Louise Archer’s concept of science capital refers to the science related knowledge, attitudes, experiences, and resources that an individual possesses (Archer *et al*, 2015). Drawing on Bourdieu’s theory of capital and *habitus*, Archer *et al* (2015) uses this framework to explain how social and cultural factors shape young people’s engagement with and knowledge of science. Her work highlights the persistent underrepresentation of working-class students, females, and ethnic minority groups in science, technology, engineering, and mathematics (STEM) fields. Archer *et al* (2015) identifies eight dimensions of science capital that include: scientific literacy, science related attitudes, value and dispositions, knowledge about the transferability of science, consumption of science related media, participation of out of school science learning contexts, family science skills, knowledge and qualifications, knowing people in science-related roles and talking about science in everyday life (Archer *et al*, 2015). Students with high levels of science capital are more likely to perceive science as “for them” and pursue it further. This highlights how access to resources, social networks, and cultural attitudes can significantly influence subject-specific engagement. Archer’s work (Archer *et al*, 2015) also emphasises the dynamic interplay between capital and habitus within educational fields, illustrating how identity and background shape students’ experiences and aspirations.

The *Science Capital Teaching Approach* (SCTA), developed from Archer *et al’s* (2015) research, was trialled in three secondary schools in England to make science education more inclusive. This approach encourages teachers to connect science content to students’ everyday lives, value diverse forms of knowledge, and foster inclusive classroom practices. Evidence from its implementation shows increased interest in studying science at A-level, more positive attitudes toward science, and greater classroom engagement (Archer and Dewitt, 2017). The SCTA is designed to help students find personal meaning and relevance in science, thereby enhancing their participation.

However, this thesis diverges from Archer’s focus (Archer *et al*, 2015; Archer and Dewitt, 2017) by exploring how the interplay of capital and habitus influences mathematical practices. While science capital has gained traction in educational research and practice (Chowdhuri *et al,* 2023; King *et al*, 2015; Kontkanen *et al*, 2025; , and can inform the concept of *mathematics capital*, this research within the realm of mathematics remains underdeveloped.

Williams and Choudry (2016) define *mathematics capital* as the use and exchange value of mathematics within educational and social contexts. They argue that *habitus* provides the structures through which individuals perceive and interpret the world, shaping their engagement with mathematics in statistically predictable, though not deterministic, ways. *Habitus* is formed through cumulative experiences across family, school, and peer groups. Their work also introduces measures of mathematical dispositions, further emphasising the role of social groups in shaping mathematical engagement.

Andrew Noyes (2003) builds on Bourdieu's concept of capital to examine how mathematics functions as a resource for social mobility, noting its unequal distribution across student populations. He argues that A-level mathematics is often perceived as valuable educational currency. Students with higher confidence in mathematics and stronger perceptions of its relevance are more likely to pursue it. Noyes (2003) later highlights how curriculum design, societal narratives, school culture, and teacher expectations influence students' mathematical identities and choices. He calls for more inclusive pathways that reflect the diversity of the student population.

In summary, research into both science and mathematics capital reveals a shared emphasis on the interaction between capital, habitus, and field. These frameworks highlight how broader social structures and cultural contexts shape students' aspirations and engagement with specific subjects. While science capital has led to measurable improvements in classroom practice, *mathematics capital* remains conceptually and practically underdeveloped (Jorgensen *et al*, 2014; Williams and Choudry, 2016). This thesis addresses that gap by proposing a framework to assess the impact of capital and habitus on mathematics practices and by exploring how such insights can be embedded into classroom practice.

Field

Bourdieu uses the term field as a tool to explain the different social spaces that individuals occupy that are structured and contain people who dominate and people who are dominated. Within these fields, there are constant relationships of inequality where an actor's position in the field is defined by the capital they have (Bourdieu, 1998). According to Thompson (2008), the term field refers to norms that govern a particular social sphere, for example, school, workplace and family, which are organised around specific forms of capital. Being part of a particular field, and understanding the norms, values, and behaviours associated with it, provides an individual with the capital needed to navigate and participate effectively within that field. This familiarity can also open access to other fields in society, as it equips individuals with the knowledge of what is expected in different social contexts. Bourdieu (1984) calls this the 'rule of the game' where an individual's position within a particular field derives from the interrelation of their *habitus* and the capital they can mobilise within that field.

Bourdieu's concept of field has had a significant impact on the sociology of education to understand how within the field of education, students' dispositions generated by their inherited cultural capital has an impact on their practices, and the importance of the analysis of field-specific practices (Lareau 2000, 2003, Ferrare and Apple, 2015). Field-specific practices refer to practices that are particular of that field, which is an important focus as it distinguishes between different patterns of behaviour. In this research, the term 'mathematical practices' will be used that takes inspiration from this literature where mathematical practices distinguish between those who understand and 'do' the mathematics and those that do not, which Edgerton *et al* (2013) suggests has an impact on educational outcomes.

Practice

Bourdieu does not provide a straightforward definition for his notion of practice. Warde (2004) identifies that Bourdieu never got to grips with practice shown throughout his work in *Distinction* (1984) and *Logic of Practice* (1980) where he identifies six different uses of practice. One of these definitions he explains': to identify an entity formed around an activity; a coordinated, recognisable and institutionally supported practice', and the other: 'the performance of carrying out of some action or other'. Maton (2014) identifies that practice results from relations between *habitus*, capital and field that is shown in Bourdieu's (1977) theory of practice.

Edgerton and Roberts (2014) identify that individuals' practices within school are a consequence of their *habitus* and capital within the dynamics of that field which are shaped by various factors including socioeconomic background, cultural, family and peer influences that impacts pupils' dispositions and their practices. Furthermore, Edgerton *et al* (2013) recognise that academic practices within the field of education are positively associated with academic outcomes. Proficiency in these practices are not evenly distributed due to the differences in dispositional tendencies, with the *habitus* having a very strong effect on academic practices, where valued and preferred dispositions within the field of education lead to actions that produce greater educational returns (Edgerton and Roberts, 2014). For example, within the field of mathematics and for the purpose of this research, practice refers to pupils' academic practices in mathematics; the way they engage and demonstrate their understanding of the mathematical content of the national curriculum which taking inspiration from Edgerton *et al* (2013) is positively associated with mathematical outcomes.

Although attainment levels are measured in schools and international league tables by government, it must be acknowledged that literature also focuses around educational outcomes which encompasses attainment levels alongside skills, knowledge and positive attitudes towards learning. In this research the focus is on the social and cultural impact on *Mathematical Habitus* which is suggested impacts on educational outcomes (Edgerton *et al* 2013; Harland *et al*, 2024).

Mathematical Habitus

Mathematical Habitus is a concept that has not been widely acknowledged, but where it has been, has a variety of views and interpretations (Zevenbergen 2005, 2007; Kennedy, 2012). Kennedy (2012) refers to *Mathematical Habitus* as a set of dispositions towards mathematics that is influenced very early by parental views and familial stories. She uses Bourdieu's linguistic *habitus* 'a subset of dispositions acquired in the course of learning to speak in context like family, school and peer groups' (Kennedy, 2012: 428) to explain *Mathematical Habitus* as a 'subset of dispositions acquired in the course of learning mathematics' (Kennedy, 2012: 428). Kennedy (2012) recognises that these dispositions will inform mathematical practices, expectations of those practices and the value that students ascribe to the practices.

Alongside this definition of *Mathematical Habitus*, Kennedy (2012) also recognises the impact of socio-demographic factors such as gender, race and class on the impact on *Mathematical Habitus*. She recognises these characteristics as internalised social structures that are inescapable and have been structured by that same culture that inform mathematical practices, expectations and the value that pupils ascribe to the practice of mathematics. Bourdieu and Passeron (1990) argue that there are various types of cultural bias that cause symbolic violence that can limit the experiences, aspirations and expectations of pupils. Martin

(2013) emphasises the impact of race on mathematical attainment by explaining "the widening gap between those who are mathematically literate and those who are not coincide to a frightening degree with racial and economic categories." Here, Martin touches on the 'feel for the game' (Bourdieu, 1984) of what is acceptable and valued according to different socio demographics, but also how the capital one has can become embodied and produces different practices for different groups of people (Bourdieu 1984, Kennedy 2012). Kennedy (2012) emphasises the importance of socio-demographic factors on the value pupils place on different mathematical practices which are also dependent on the distribution of different kinds of capital. School maths practices are guided by an inevitable positioning in relation to the distribution of different kinds of capital, thus an individual's participation in mathematical practices can be understood as the product of the relationship between *habitus* and field. This highlights a need to look at the intersection between socio-demographics, capital and *habitus* in creating a *Mathematical Habitus* that directs our mathematical practices within the field of education.

Collective *Mathematical Habitus*

As well as an individual *Mathematical Habitus*, Zevenbergen (2007) refers to a collective *Mathematical Habitus* where students consistently reported similar experiences based of their level of ability grouping across all the key variables. Those who were in higher streams displayed more positive experiences of maths, performed better and considered maths as relevant, whereas those in the lower streams displayed negative experiences of maths that resulted in very different math *habitus* depending on their ability groups (Zevenbergen, 2005). Zevenbergen (2007) believes that the structuring aspect of the field such as the curriculum, assessment and teaching differences between the higher and lower ability sets were identified as contributing to the construction of views and dispositions towards school mathematics between groups. This suggests that ability setting may play a powerful role in determining dispositions towards mathematics, however according to Kennedy (2012), Bourdieu conceives *habitus* as a multi-dimensional concept, with the need to look at different levels of society such as the classroom, individual and different fields (home and school) to explain *habitus*. This highlights the complexity of *habitus* and suggests that ability setting alongside other influences such as family, peers and capital must be considered when exploring the idea of *Mathematical Habitus*.

There is a link between social class (measured by eligibility for free school meals) and ability setting, that a higher proportion of those eligible for free school meals make up the majority of those in lower ability sets, compared to those in the higher ability sets (DfE, 2013). As suggested by both concepts of collective maths *habitus* (Zevenbergen, 2005, 2007) and the reconfirmed *habitus* (Ingram and Abrahams, 2016), where an individual is amongst a group with similar dispositions, commonly due to their social class, there will be less room for reflexivity in the *habitus*. In classrooms where there is a larger mix of people from different backgrounds (class and ethnicity, to name a few factors), there may be more opportunity for a reflexive *habitus* due to those pupils being in an environment with people that have different norms and values to theirs, that could be beneficial to their mathematical practice.

Reflexive Mathematical *Habitus*

Similar to the idea of reflexive *habitus*, the same concept can be applied to a reflexive maths *habitus*. Kennedy (2012) acknowledges that maths *habitus* is made up of a complex intertwining of collective and individual histories that turn into “nature,” which structure all individual and collective action and inform mathematical classroom practices. Children have mathematics classes up to 5 times a week. Amongst those pupils are a variety of different backgrounds and experiences, with those from similar cultural backgrounds allowing for a collective maths *habitus* to be formed amongst those individuals, with those from a different cultural background having the possibility for their individual *habitus* to change as a result of these interactions (Kennedy, 2012). Pupils are exposed to counter training (Bourdieu, 2000) each day by the repetition of lessons where teachers tell pupils of the value and importance of gaining a pass at GCSE mathematics, and the content they are learning. Additionally, pupils’ socio demographic factors and capital formed from primary socialisation impact the value pupils place on the subject, alongside the potential of interacting daily with pupils with different values and experiences (Kennedy *et al*, 2012). All this provides a number of influences on the *Mathematical Habitus* that can change or fixate the *habitus* depending on the capital and experiences an individual has within the field of education, that can influence pupils' mathematical practices.

Attitudes, dispositions and *habitus*

Attitudes and dispositions are closely linked. Attitudes are defined as a learned predisposition that incorporates beliefs, feelings and actions towards a subject, whereas dispositions are the internalised set of beliefs, values and practices that shapes an individual understanding and interaction with the social world (Bourdieu 1977; Thurstone 1928 cited in Fishman *et al*, 2021). Beyers (2008) outlines mathematical dispositions to be the tendency to have or experience particular attitudes, beliefs, feelings and emotions towards mathematics. It is these set of internal dispositions that comprise the *habitus* which is influenced by the individuals' positions in the social structure. The individuals' practices within a certain field (school) are the consequence of their *habitus* and capital within the dynamics of that field (Edgerton and Roberts, 2014) that are shaped by various factors, including socioeconomic background, cultural and family influences, school environment and peer influences that impacts our dispositions that impact our practices. Here, the interconnectivity between attitudes and dispositions is evident with the acknowledgement of the impact of social and cultural capital that influences dispositions, all embedded within a particular field. For this research, field is referred to as mathematics education.

Bourdieu (1977 cited in Gaddis, 2012) suggests a lack of cultural capital adversely shapes the attitudes and outlooks of pupils that come from disadvantaged backgrounds, resulting in negative dispositions towards schools that affects educational achievement and attainment. In order to achieve educational success, students must use the capital they have received from their families, communities and previous experiences. If this aligns with the dominant culture, this can result in positive feedback from teachers which builds students confidence, thus altering their *habitus* (Gaddis, 2012). Edgerton and Roberts (2014) identified that valued or preferred dispositions lead to actions that produce educational returns, therefore it is important to consider what factors impact these favoured dispositions. This thesis focuses on gender, ethnicity, free school meal eligibility, speaking English as an additional language, parent attitudes and peer attitudes due to existing evidence that indicates these factors contributing to educational outcomes.

Pupil attitudes

An attitude towards mathematics is a person's feelings, beliefs, and behaviours toward mathematics which includes difficulty, liking, anxiety, happiness and ability (Thomas and Dowker, 2000). Dowker *et al* (2019) suggests that mathematical ability is dependent not only on cognitive ability, but also on emotional factors and attitudes toward mathematics. Those with positive attitudes towards mathematics predict mathematical achievement even after multiple other factors were taken into account (Chen *et al*, 2018). This is supported by Veresova and Mala (2016), that discovered that learner's attitudes towards school were a determinant factor in predicting their academic achievement, and recent findings from TIMSS (2023) that suggests that positive attitudes towards learning positively impacts achievement (Von Davier *et al*, 2024). Those who liked learning maths had substantially higher achievement than those that did not like maths, with almost half of pupils reporting that they do not like maths. Attitudes are important to acknowledge due to this wealth of literature that suggests positive attitudes lead to positive outcomes (Veresova and Mala, 2016; Chen *et al*, 2018; Von Davier *et al*, 2024).

Gender

There is much debate around gender differences and mathematical attainment due to conflicting evidence. Historically, pre-1991, males consistently outperformed females (DfES, 2006). Literature explains these gender differences being present due to the deep-rooted historical context of mathematics being culturally accepted as a ‘boys subject’ due to gender roles and stereotypes in society. Men were seen as rational whereas females were seen as emotional, and due to mathematics being an objective subject, this acted as a socially accepted way to culturally exclude women (Paechter 2001, O’Rourke and Prendergast, 2021). Due to the feminist movement, there was a big drive to narrow the attainment gap between males and females with the introduction of GCSE’s and introduction of coursework with the 1988 *Education Act* playing a significant role in the increase in girls’ performance in education (The Sutton Trust, 2024).

Recent statistics show that females now outperform males with 73.7% of females achieving a grade 4 or above in GCSE mathematics compared with 67.1% males, with this gap between males and females continually narrowing since 2019 (DfE, 2024b; Education Policy Institute, 2024), which indicates that females have overtaken males in academic performance. Despite this rise, females are still less likely to consider further study or a career in Science, Technology, Engineering, and Mathematics (STEM) with only 37.7% of females going onto further education and only 26% of the STEM workforce made up of women (McGee, 2024; Census, 2024). This trend continues into higher education where only around one third of first-degree maths entrants are women, which has seen very little change over the decade (Wakeling, 2024). Alongside this, there is also a rapid growth in the number of males graduating in these subject areas and high numbers of female students enrolling in subjects such as Psychology and Nursing (Census, 2024) which are often amongst the lower-paid career routes, showing a continued disparity between males and females and mathematical careers.

This suggests the importance of acknowledging the intersection between gender, ethnicity and free school meal eligibility (Roberts *et al*, 2024), with key studies such as Willis (1977) *Learning to Labour* and Ingram (2009) *Working-Class Boys and Educational Success* highlighting the performance of males in education according to their social class status. Gender research in education has been dominated with the narrative that girls outperform boys, however when comparing the percentage of males and females that pass GCSE mathematics with a grade 4 or above it is important acknowledge how this is measured. Achieving a grade 4 or above in mathematics is considered a pass and is the threshold to compare attainment levels between groups, school league tables and provides an indicator to explore educational inequalities. What using this threshold and research does not tell us is the percentage of males and females that attain a grade 9 or above, the highest GCSE grade, which is needed to access most further study and careers in STEM. So, although the data provides evidence that there are no or minimal gender differences, we are unsure how this translates to gender differences of the highest academic achievers, which may show a different outcome and could be an explanation for the gender differences in STEM careers and future study.

More recently, there has been more attention given to how gender can have an impact on attitudes towards mathematics and maths anxiety that has been shown to have an impact on mathematical attainment (Bashir *et al*, 2023). It has consistently been found that females have lower self-concept and higher anxiety than males, with the need to focus on cultural and social reasons for females negative attitudes (O'Rourke and Prendergast, 2021; Goldman and Penner 2016; OECD 2016). Watt (2006) identified that girls viewed mathematics as important, they did not find it likeable or interesting, whereas TIMSS (2019) found that boys like learning more and were more confident in maths than females (Richardson *et al,* 2020). Furthermore, Bashir *et al* (2023) looked at gender differences between males and females and their attitudes towards mathematics incorporating anxiety, confidence, self-concept, value and the utility of mathematics, and found that females had more anxiety and males had more confidence, self-concept, value and utility towards mathematics, with parents also having an impact by expecting more from males than females. Meece *et al* (2006) also found that gender influences pupils value of mathematics that impacts engagement and performance. However, despite these differences, there were no gender differences found in overall academic achievement.

Overall, there is a consensus in government statistics that there are no gender differences in mathematics attainment levels when using the grade 4 pass threshold (DfE, 2024b), however some research indicates that differences in attitudes towards mathematics between males and females impacts mathematical attainment due to attitudes having an impact on motivation and engagement with the subject (Richardson *et al*, 2020).

Ethnicity

Ethnicity is an important factor when looking at differences in attainment levels, with much recent emphasis on the matter due to the underperformance of some ethnic groups (DfE, 2024). Historically in the UK, those from ethnic minority backgrounds underperformed in education compared to their white counterparts, however in the late 1980's this started to change with those from an ethnic minority background having the desire to stay in education and acquire qualifications that far exceeded the desire of their white counterparts (Tomlinson, 1991). Despite this, ethnic minorities continued to do less well, with those from a Black-Caribbean background performing less well than any other ethnic group, despite them being more likely to stay in education. Research from Tomlinson (1991) suggests that the selection of school had an important role in this, with those from a Black-Caribbean background being four times more likely to be allocated schools described as educationally subnormal. Similar to the trajectory of gender and education, the historical context which ethnicity embeds itself in society is important to acknowledge. It was a societal norm that those from ethnic minorities attended different schools, with racism being a major influence in this. However, despite these challenges, recent statistics show a huge change in educational outcomes for those from ethnic minoritised groups (DfE, 2024b).

The Department for Education (2024) released that most ethnic groups achieve higher GCSE grades than white British pupils in 2023, with 88.6% of Chinese pupils' achieving a grade 4 or above in mathematics compared to 63.6% of white pupils, with Chinese pupils' attainment being 27 months ahead of white British pupils. This difference, especially amongst Chinese pupils' attainment is what got the attention of recent policy to implement the Mastery method in schools, as TIMSS and PISA reports found that Britain as a whole were behind China in the international league tables for mathematics attainment. Therefore, the Teacher Exchange programme (2016) was funded by the UK government to train teachers to implement the mastery method of teaching that was thought would increase mathematical attainment in the UK. Boylan *et al's* (2019) evaluation provided evidence that it is not the method of teaching maths, but rather the social and cultural aspects related to the pupils that impacts educational attainment.

Ethnicity is closely linked with cultural practices, norms and expectations that can impact educational success. Modood (2004) calls this ethnic capital where ambitions to achieve upward social mobility through the use of education, influenced by parents, relatives and community members are practices and norms that are favoured by the education system that can enhance pupils' outcomes, or similarly those that do not align can decline pupils' outcomes. Wakeling (2024) identifies that this trend continues into higher education with Chinese and Indian students being more likely to study mathematics at degree level than any other ethnic group, with black students being relatively underrepresented. The

Department of Education and Science (1985) highlight that researchers often search for a single factor to explain a complex situation, with the need for family structures, cultural differences, socio-economic background, self-esteem and racial prejudice to be considered as explanations for educational outcome differences (Tomlinson, 1991).

The Sutton Trust (2016) found that in the past ten years Bangladeshi, Black African and Chinese pupils have improved substantially more than the national average, with the performance of those from an ethnic minority background overtaking that of White British pupils. Those from Gypsy Roma and Irish Travelling communities perform the lowest which is highlighted due to the lack of stability and educational challenges they face (The Sutton Trust, 2016). This hints at favouring cultural practices and norms by the education system to be 'successful'. There have also been policies implemented such as the *Ethnic Minority Attainment Grant* 1999 in aim to tackle inequalities in attainment levels in minority ethnic groups in comparison to their white counterparts by providing funding to help support those from underachieving minority ethnic groups. Although the initiative seems successful for the majority, there were no changes in academic achievement for those from Black Caribbean backgrounds (Tikly *et al*, 2006). Since then, evidence suggests that the achievement gap now exists between white and minority ethnic groups with ethnic minority groups consistently outperforming those from a white ethnic background, although TIMSS (2019) found no significant difference between ethnicity and mathematical performance (Richardson *et al*, 2020).

Overall, the consensus is that those from a white ethnic background underperform when compared with their ethnic minority counterparts, however the way ethnicity is measured and categorised must also be considered. Recently, there has been an emphasis on using BAME (Black and Minority Ethnic) to measure ethnicity, however this does not take into account the differences between ethnic groups. For example, all ethnic minority groups will be put together such as Black, Asian and other, however there are clear differences between these ethnic groups, but even amongst a category of the black ethnic group with previous research showing differences between Black-Caribbean and Black African amongst educational attainment (Tikly *et al*, 2006). Furthermore, it must also be acknowledged that cultural practices and norms are closely linked with ethnicity (Evans and Field, 2020; Modood 2004) with research suggesting the need for the impact of ethnicity to not be used alone, but in relation to other social and cultural factors.

Free school meal eligibility

Free school meals fall under section 512 of the *Education Act* 1996 for schools to provide free school meals to pupils of all ages that meet the criteria. Two key elements are that parent's annual income is no more than £7400, or the child's parents must be in receipt of benefits (Gov: online). Due to this, free school meals are often used as a proxy for socio-economic status especially amongst governments and schools as it provides a consistent way to measure what impact socio-economic status can have on educational outcomes. There is the desire amongst researchers to make the best possible use of the measure of free school meal eligibility for knowledge-building and social good (Campbell and Cooper, 2024).

Although widely used, it is acknowledged that free school meals may not be an accurate measure of socio-economic status (SES) as although SES can include a wide set of variables that gauges social, cultural and financial capital, linked to social class, it is commonly measured by parental education, parental occupation, and income (Long and Renbarger, 2023). Due to this, this research will refer to free school meal eligibility as a proxy for socio-economic status with the acknowledgment of its links to social class, as it is still widely used within educational research, policy and schools, and provides a way to understand inequalities within the education system.

Free school meals and its impact on educational achievement has gained lots of attention over the years due to its relationship with poor educational outcomes. Francis-Devine *et al* (2024) found that 43% of pupils that received free school meals passed both English and Maths compared to 72% of those that did not receive free school meals, with this narrative being consistent amongst most research (ONS, 2021; The Sutton Trust, 2024). This coincides with TIMSS (2019) that found that those eligible for free school meals scored lower in their mathematics performance compared to those that were not eligible for free school meals (Richardson *et al*, 2020). The Sutton Trust (2024) research focus is free school meal eligibility and attainment gaps, and found that children from less well-off homes start school already behind their peers, which widens further through primary and secondary school due to the links of social class to economic and social capital.

Tutoring is a key method of boosting academic achievement (The Sutton Trust, 2024). There are significant socio-economic gaps in access to private tutoring. While these gaps have been levelled out by the National Tutoring Programme, with 27% of those eligible for free school meals reporting they received tutoring from school in 2023, the National Tutoring Programme (NTP) ended in 2024, removing a vital tool to address the attainment gap. The Sutton Trust (2024) addressed how inequalities in education are a ticking time bomb for social mobility and social cohesion, therefore unless there is a renewed focus on tackling the attainment gap, this gap will continue to widen. Evidence from the COVID-19 pandemic shows that the attainment widened considerably, wiping out a decade of progress due to the pause in access to interventions such as the NTP (The Sutton Trust, 2024).

Research also suggests that being in receipt of free school meals also affects future careers and earnings, with only half of students that were eligible for free school meals earning more than £17,000 aged 30 years, and those from income deprived backgrounds being much less likely to onto higher education with the earnings gap considerable widening around university graduation age (ONS, 2021). Interestingly, when comparing those students who received the same level of qualifications and attainment, those who were eligible for free school meal still went on to earn less (ONS, 2021). Friedman *et al* (2015) explore the concept of the class ceiling where future careers and earnings relate to the individuals' social class, with Wakeling (2024) identifying that maths degrees have a lower proportion of students from socioeconomically disadvantaged backgrounds and has seen a shift towards more advantaged students over time. This suggests the impact of free school meal eligibility on future trajectories and earnings, despite the pupils' GCSE mathematics grade. However free school meal eligibility also intersects with other factors such as gender and ethnicity and these characteristics never exist independently. Therefore, this highlights the need to consider the links between socio-cultural factors and how this impacts on pupils mathematical practices and future aspirations.

English as an additional language

English as an additional language refers to pupils who are learning or have learnt English in addition to their first language. Due to the change in population movement globally, more children are entering the UK education system with English as an additional language that has doubled and continues to rise (Schneider and Arnot 2017). According to DfE (2019) the attainment of those who speak English as an Additional Language and those who English is their first language is very similar, due to the variance in English language skills. Mathematics requires a good level of reading comprehension and phonological processing as worded questions make up 20-30% of the exam paper and requires a higher level of English proficiency as the difficulty increases (Fuchs *et al*, 2006), which Vista (2013) explains to be problematic for non-native speakers. Language proficiency can be affected by numerous factors such as the time lived in England and the first language of the pupils (DfE 2019; Strand *et al*, 2015). This is not taken into account when discussing performance in exams, or access to the learning of mathematical content in classrooms, due to language barriers. The English as an additional language measure used extensively throughout research and policy does not take these factors into account. Due to the inconsistencies between research and outcomes using this measure, in 2017 the Department for Education introduced a new proficiency in English measure, however it was discontinued after the 2018 school census and has not since been replaced (Strand *et al*, 2015).

When mathematical performance was measured in TIMSS (2019) using those who speak English as an Additional Language and those who do not, it is not surprising that no significant difference was found due to the inaccuracy of the measure of English as an additional language (Richardson *et al*, 2020). Furthermore, the sample size of those pupils who spoke English as an additional language was particularly small as one quarter of schools had less than 1% of pupils recorded as EAL, with 1 in 11 school having over 50% of pupils that spoke English as an

Additional language. This highlights that not only sample sizes were varied, but how pupils who speak EAL were concentrated into fewer schools.

The language proficiency between those pupils who speak English additionally but have lived in England all of their life, and those who have arrived to England recently will vary considerably (DfE, 2019b). The impact of the understanding of the English language is important to consider when looking at mathematics attainment as part of the GCSE mathematics exam, as problem solving and worded questions make up 20-30% of the exam paper and requires a higher level of English proficiency as the difficulty increases.

It is also important to consider how English as an additional language intersects with ethnicity, as part of the *Ethnic Minority Attainment Grant* 1999 was to help those of ethnic minority backgrounds and those that speak English as an additional language to increase their educational attainment and minimise the attainment gap. The Sutton Trust (2016) recognise the success of this intervention as the attainment gap has closed between ethnic groups, with interventions of those who speak English as an additional language being one key element of the policy. The influence of family attitudes towards education is also crucial to consider. For example, 71% of pupils from Black backgrounds speak English as an additional language (Strand *et al*, 2015). Despite generally lower academic performance, students from ethnic minority groups often demonstrate a stronger desire to remain in education compared to their white peers, reflecting the high value placed on education as a means of achieving upward social mobility. This highlights the significant role of cultural and family values transmitted through primary socialisation in shaping educational aspirations and success (Tomlinson, 1991; Modood, 2004; Evans and Field, 2020). Despite a GCSE gap for late-arriving EAL pupils of 20.7 months in 2019, this time also seen a rise in Chinese pupils arriving from overseas speaking English as an additional language, where they continue to be the highest performing ethnic group despite their late arrival and speaking English as an additional language (Education Policy Institute, 2023). This indicates the complexity of measuring English as an additional language and its impact on attainment levels.

Extra Maths tuition

Extra maths tuition can significantly improve pupils' attainment, leading to an average of an additional five months of progress, especially for those from disadvantaged groups that are likely to benefit (EEFb, 2021; DfE, 2024). The National Tutoring Programme was introduced in 2020 to deliver tutoring at scale for those that required extra support after the impact on education during the COVID-19 pandemic, with 59.4% of schools participating in the programme (DfE, 2024). An evaluation report by the Education Development Trust (2024) found that prior to tutoring sessions 18.4% of pupils were working at or above the expected standard in maths compared to 61.2% after the sessions, with engagement being a key factor in determining the outcomes of the pupil and gaining parent support to encourage pupil participation.

There is also private tuition that provide extra tuition for those high income families to maximise their children's chances of achieving their highest possible grade and is often used when a child from an affluent family is in danger of failing their GCSE English or Maths (The Sutton Trust, 2017). More of those from disadvantaged backgrounds report not having the money or ever considering extra maths tuition compared to their more advantaged peers. Ireson (2004) highlights the impact of international comparisons of pupils' attainment such as TIMSS and PISA that found that high educational attainment was coupled with economic success, with many countries in East and South Asia having children that attend private tuition at the end of a normal school day. This highlights two different needs for extra tuition; for those from disadvantaged groups to 'catch up' and those who are economically advantaged to attain the highest grade possible.

Parents' Help with Homework

Findings from the TIMSS 2019 report found that parental support with homework was found to positively influence academic achievement and improve the development of key learning skills (Harvey and Reddy, 2021), with Fiskerstrand and Hannula (2024) highlighting the inconsistencies in research when establishing whether parents help with mathematics homework hinders or promotes mathematical achievement. 50% of those from disadvantaged backgrounds reported that parents help them regularly with their homework compared to 68% of those from advantaged backgrounds which indicates an 18% socio-economic gap, with pupils in China only having a 5% socio-economic gap. This highlights the differences in parental engagement with their child's education between countries (The Sutton Trust, 2017). Furthermore, Boylan *et al* (2019) highlights the importance of involvement from parents and the difference in cultural values in parents towards their child's education. However the National Numeracy (2024) found that 23% of parents found that helping their child with their maths homework makes them anxious, with 20% admitting that maths homework has caused arguments at home indicating some negative effects of parents help with homework where this anxiety can be handed down from parents to children (National Numeracy, 2024).

Parents' attitudes

Evans and Field (2020) indicate that parents play an extremely important role in their child's educational success that can have both positive and negative effects. Cultural patterns, habits and skills are created and reinforced by parents during early socialisation that influences educational expectations and impacts on educational attainment (Lareau, 2003; Dumais, 2002). Parents transmit their attitudes, interest, value and anxiety of mathematics that influences their child's involvement in educational practices and attainment (Evans and Field, 2020; National Numeracy, 2024). Dumais (2002) found that early socialisation is crucial in forming children's ideas of themselves that are durable and transposable from one setting to another. This early socialisation develops dispositions that influence the actions a child takes which will impact on their educational attainment as educational expectations are part of their *habitus* (Dumais, 2002).

Lareau (2003) argues that social class based cultural patterns, habits and skills are created and reinforced by different parenting practices that provides children with a sense of what is comfortable or what is natural. For example, poor working-class parents saw themselves primarily responsible for physical needs such as clothing, food and housing, whereas middle and upper class parents focused more on the development of their children's skills, interests and behaviours. Furthermore, Bodovski (2015) identified that children raised in families from a higher social class believe that they are capable and deserving of higher educational attainment and that their own actions and behaviour will allow them to achieve it. Parents have been found to transmit maths anxiety, attitudes towards and interest in maths, all of which are associated with maths attainment (Evans and Field, 2020). Edgerton and Roberts (2014) argue that the educational practices of pupils comes from their family *habitus* and cultural capital, where those with the *habitus* transmitted from their parents from middle class backgrounds holds more currency in formal institutions such as schools, and translates to differences in educational attainment and socioeconomic outcomes (Roberts and Edgerton, 2014). These differences in children's upbringing, associated with social class, influences the child's dispositions towards what is expected of them at school that has an impact on their educational attainment (Edgerton and Roberts, 2014). Therefore, it is important to acknowledge how parental attitudes and expectations intersects with social class, with consideration that this is not to blame parents for their child's educational success, but to understand how the education system favours particular attitudes and values associated with different social classes and parental practices.

Furthermore, Bourdieu and Passeron (1990) argue that children profit the most from parental cultural capital when their parents are of a high social status, if parents have accumulated greater amounts of cultural capital. Those children with parents of a higher social status with more cultural capital are better prepared for higher levels of education and receive greater rewards during their educational career. This presents an argument for the need for research to understand how parental attitudes impacts pupils' mathematical practices.

Parental involvement takes many forms including a stable home environment, social and educational values, aspirations, participation in school and intellectual stimulation (Desforges and Abouchaar, 2003), with the extent of this involvement strongly influenced by social class, deprivation, parental level of education and ethnicity (Desforges and Abouchaar, 2003). Research suggests that parental involvement has an effect on educational attainment with academic success being impacted indirectly through parents' beliefs and expectations which can be both positive and negative (David-Kean *et al*, 2021; Education Empowerment Foundation). Liu (2018) discusses the intergenerational transfer of ability and knowledge through biological and environmental pathways through beliefs and activities parents provide for their children, which Davis-Kean and Sexton (2009) found parents beliefs and behaviours to account for 19-30% of variance in the data when looking at parental influence on pupil achievement. Here attention can be drawn to Bourdieu's notion of cultural capital that translates through and across generations (Bourdieu and Passeron, 1990).

Parents demographics

Research on the impact of parental demographics is limited, where much research regarding parents focuses on parental involvement in the child's schooling and education (EEF, 2021; Hattie, 2008). Hattie (2008) found that the effect on parental involvement in a child's journey throughout school is equivalent to adding two or three years to that's students' education. The Parentkind report (2021) shown that 85% of parents want to play an active role in their child's education, but time was the biggest barrier for them. This research differs as it is interested in how parents' demographics may impact pupils' educational outcomes.

Parents gender

Research on parents gender on educational outcomes is limited. Mothers are more involved in daily school activities and homework than fathers, however fathers' involvement influences children's attitudes towards maths and science by promoting a stronger interest in the subjects that increases their child's performance (Mapanje, 2024). This highlights the impact of parental gender roles on their children's academic performance and the need for research.

Parents ethnicity

Parents from different ethnic groups hold different cultural values and ethnic capital, where the ambitions to achieve upward social mobility through education and the transmission of norms and practices, favoured by the education system, can be influenced by parents (Modood, 2004). Stokes *et al* (2015) also highlights the differences between parental expectations and aspirations between different ethnic groups, with Strand (2014) suggesting the immigrant paradigm where recent migrants will put greater emphasis on education as they have less financial capital. So, although ethnicity itself does not directly impact pupils' educational outcomes, it is suggested various factors linked to ethnicity such as the transmission of norms and values, socio-economic status and parental engagement does (Stokes *et al*, 2015).

Parents that speak English as an additional language

Research by The Bell Foundation (2025) identify that parental involvement is an important part of a child’s learning and academic success, with those parents that speak English as an additional language experiencing language and communication barriers when engaging with schools. Rodriguez-Brown (2009) cited in The Bell Foundation (2020) explains that parents that speak English as an additional language felt anxious due to their own lower levels, or lack of, formal education, with Evans *et al* (2016) identifying the lack of support at home with pupils’ homework and assessments due to the language barrier. Therefore, to support communication and engagement with parents that do speak English as an additional language, The Bell Foundation (2020) suggests for schools to seek translation of important documents to ensure important messages are delivered to parents and to increase their engagement with schools. The impact of parents that speak English as an additional language on pupils attainment is not known, but EEF (2021) suggests that those parents that engage more with a child’s education have better educational outcomes than those that do not.

Peer attitudes

Research on the influence of peers on pupils’ educational achievement is limited despite theories suggesting that peers and friendship groups impact educational success. The Coleman Report (1966) identifies that the most significant determinant of pupils’ attainment apart from their own ability was the ability of their classmates. From then, many economic theorists have used theories such as the human capital investment theory to try and understand how peers affect pupils, especially how a pupil will decide whether or not to invest in anything based of the expected costs and benefits (Sokatch,2006).

Although Bourdieu is critical of this argument (Bourdieu 1977; 1984), during teenage years, friends can be one of the most influential factors on pupils’ attainment as it is their friends that pupils see most days, where they share the same activities and develop close relationships that influences friends’ behaviour and learning (Molloy *et al* 2011; Bakar *et al* 2021). Therefore, a pupil telling their friends their liking or disliking of maths may be weighed up against the costs and benefits of whether they would be accepted into that friendship group according to their likes and dislikes. Ryan et al (2019) argue that peers' opinions and expectations about each other's Mathematical attainment matters for their own Mathematical attainment. This motivation to change our attitudes is driven by external factors such as social recognition, which then impacts individual behaviour (Shao et al, 2024).

Teachers' Gender

The impact of teachers' gender on pupils' educational outcomes highlights the influence of perceived gender roles in mathematics. Teachers may hold biases that view STEM subjects as a male domain, making them less likely to encourage girls to pursue these subjects (Copur-Gencturk et al, 2023). Therefore, female teachers provide female pupils with daily role models, helping them realise that mathematics is not exclusive to men which boosts females' confidence in the subject and encourages them to overcome the negative influence of stereotypes (Marx and Roman, 2002). Furthermore, research by Gong *et al* (2018) suggests that the teachers' gender can significantly influence pupils' outcomes with female teacher often associated with positive effects on pupils' academic performance, especially female pupils. Research on the impact of teacher's gender is limited, as much research focuses on teachers perceptions of gender roles on pupils attainment (Keller, 2001; DfE, 2020). However, research does suggest that teachers do have an impact on pupils value and confidence of mathematics (Harackiewicz *et al*, 2012; Marx and Roman, 2002).

In-school value

In-school value of mathematics refers to the pupil's belief that what they learn in the classroom will help them to pass the exam. The Advisory Committee on Mathematics Education (2011) argue that schools teach to the test, with the purpose of education and lessons is to help pupils to pass the exam, with no acknowledgement of any other skills children develop especially during their time in secondary school. Onion (2004) found that the majority of 14–16-year-olds thought that the mathematics they are taught is only useful in mathematics lessons and for exams. This suggests that pupils do not understand the value of mathematics outside the classroom. This research is also interested in what influences this view and whether pupils can distinguish between the use of the maths content to pass the exam, and the value of gaining a pass at GCSE mathematics. Therefore, it is important to measure this to distinguish between the In-School and Out-School value of mathematics.

Out-school value

Out-School value refers to pupils' belief that gaining a GCSE mathematics qualification will open up more career opportunities for the future. DfE (2015) explains one of the purposes of education to be an engine of our economy, to increase employment levels by ensuring children have the skills and knowledge they need to be successful. However, National Numeracy (2023) recognise that GCSE's play a vital role in shaping pupils' future career options with GCSE mathematics acting as a gateway to further education and career opportunities, but was not always an essential criteria to careers in the way that it is today. 22% of adults identify that by not having at least a level 2 in mathematics has had a large impact on their life in relation to their career.

GCSE mathematics can be compared to money: it is used as credit to gain access to further education and different careers which Vinner (1997, 2000) calls the schools credit system. It is not the necessity of the mathematic skills pupils learn for their professional future or everyday life, it is because of the selection role mathematics has in all stages of our educational system (Vinner, 2000). Pais (2013) argues that the value of mathematics is a result of the formal place it occupies within late capitalism. The skills pupils develop to pass GCSE maths exam are not needed for specific careers, but is still a requirement to gain access to it. The content taught in GCSE maths (number, geometry and measure, algebra, ratio and proportion, probability and statistics) are not used in many jobs roles or further education courses, highlighting how gaining a maths qualification is used as credit, to gain access to different spaces within the social structure rather than using the actual content learnt in mathematics classrooms. Students learn that in order to have a career, they have to pass mathematics at school as jobs require this as a prerequisite, even though this is no use for their work. The unimportance of mathematics for their future career or everyday life remains in the shadow as pupils accept the importance of mathematics to pass school (Pais, 2013).

Relevance

The relevance of mathematics refers to the belief that pupils will use the maths they learn in the classroom in everyday life, with Hernandez-Martinez and Vos (2018) explaining that relevance is a connection between the topic being learnt, its usefulness, and the learner. Sanchal and Sharma (2017) identify that how pupils see the relevance of mathematics influences their mathematical attainment.

Mathematics is frequently perceived as an abstract concept with the usefulness of mathematics often described as an effective tool for thinking, communicating and problem solving, and an essential tool to gain access to career opportunities without reference to the actual usefulness of the mathematical content pupils learn at school (Hernandez-Martinez and Vos, 2018). The usefulness of mathematics is said to ‘give relevance’ to mathematics (Hernandez-Martinez and Vos, 2018). Many students in mathematics classrooms ask the question “Why do I have to learn this?”, with the standard answer from teachers being “because it will be useful later” which temporarily silences the question, but is not a satisfying answer for the pupil as it does not explain how, why, where and what mathematics is relevant for, to a pupil. Therefore, it is not surprising that many pupils do not understand mathematics to be a relevant subject, with pupils not being able to see the relevance of mathematics to their current or future lives outside of school (Hernandez-Martinez and Vos, 2018; Onion, 2004).

Niss (1994) outlines his relevance paradox where the function of mathematics in society contrasts with mathematics in the classroom. Pupils experience a paradox by not finding mathematics relevant to them but understanding they need it, where pupils are always in a situation of conflict. This aligns with Ingram and Abrahams (2016) reconciled *habitus* where pupils can navigate two different fields by drawing on different aspects of their *habitus* that requires greater reflexivity, but also the destabilized *habitus* where pupils try to navigate two different fields but are always in conflict by feeling like they do not fit in. Conflict arises from experiencing two different fields that do not align with each other and having to navigate through both spaces. Those that may hold more capital in those spaces may have an increased feel for the game (Bourdieu, 1984) having a better idea how to navigate through them. Due to this tension and conflict, Niss (1994) argues that students experience a lack of connection (subjective irrelevance) between not finding mathematics relevant to them, but knowing they need it. However, it must be acknowledged here that all is dependent on the social and cultural capital a pupil has to be able to navigate through and hold those dispositions.

The relevance of mathematics spans across may aspects of people's everyday lives, with two main characteristics being home life and work life. Hall *et al* (1999) found that employers and employees regard much of what is taught in GCSE Mathematics as not directly relevant to the workplace, questioning what Nick Gibb (DfE, 2015) mentioned at the Education Summit about education being the engine of our economy and essential preparation for adult life. How mathematics prepares pupils for everyday life is questionable, with many politicians highlighting the transferable skills that mathematics offers such as problem solving, critical reasoning and logical reasoning (DfE, 2012; 2021; 2024d) which other subjects also offer. Furthermore, there is also an argument that proficiency in everyday mathematics does not necessarily translate to good performance in school mathematics (Lave and Wenger, 1998; Nunes, Schliemann and Carraher, 1993). Everyday mathematics refers to the content taught within the number topic such as operations, decimals and percentages, but only makes up 15-25% of a GCSE exam paper, therefore highlights a disparity between what is being taught in the classroom, tested on exams and use in everyday life. These differences are further highlighted in government documents (DfE, 2012; 2021; 2024d) that distinguishes between mathematics and everyday mathematics for the workforce.

Gravemeijer *et al* (2017) argues that the role of mathematics in our society is changing as mathematics is increasingly done by machines which impacts future job requirements and the type of mathematics one needs to understand the world. There is a paradox that in spite of the central role of mathematics in our society, only very few people do the maths. The operations we are taught in primary and secondary school can be performed by computers, therefore creates a tension between what is going on in society and what is being taught in schools.

Confidence

Confidence refers to the belief that pupils believe they can perform the mathematical tasks expected of them for their age group. Galbraith and Haines (1998) explain that confidence is a belief pupils obtain where they do not worry about learning hard topics, expect to get good results and feel good about Mathematics as a subject. Research by Kunhertani and Santosa (2018) and Stankov *et al* (2014) found that confidence is one of the most influential factors affecting Mathematical achievement which coincides with research by Richardson *et al*, (2020) that found confidence to be strongly associated with achievement. Pinxten *et al* (2014) found that a strong belief in pupils ability is thought to have a significant influence on a child’s academic learning and success. It is believed that an increase in confidence encourages pupils to take more risks, face challenges and build better resilience, which will help pupils in their academic journey as they are more willing to have more motivation to keep learning that impacts on attainment (Bayat *et al*, 2019). In particular, within mathematics, student confidence is associated with higher mathematical attainment (Mullis *et al*, 2020) as National Numeracy (2023) found that a large part of how individuals view their maths ability, and how confident they feel using numbers was a dominant factor linked to increased individual numeracy scores.

Research has also found differences between demographic factors and confidence that males were significantly more confident that females, even when females obtained higher grades (Pomerantz *et al*, 2002) and those from a socio-economically disadvantaged background had less confidence than their peers (Ganley and Lubienski, 2016; OECD 2019; Richardson *et al*, 2020). Foster *et al* (2021) found when applying interaction effect analysis and taking into account gender, age and socio-economic status, males still had more confidence than females and a lower socio-economic status was associated with lower confidence levels. This suggests the need to research the factors that impact confidence and the intersectionality between these factors.

Conclusion: The need to measure mathematical *habitus*

Despite numerous targeted interventions such as the *Ethnic Minority Achievement Grant (1999*), the *Education Act* (1988), and the National Tutoring Programme (The Sutton Trust, 2024), mathematical inequalities remain. These initiatives often focus on individual demographic factors in isolation, overlooking how social, cultural, and institutional forces interact to shape educational outcomes. Increasingly, the literature highlights the need to understand this interplay, as students' experiences and attainment in mathematics are influenced by more than academic ability alone.

Bourdieu's Theory of Practice (1977) provides a robust framework for addressing this complexity. His formula, (*habitus* x capital) + field = practice (Bourdieu, 1977: 101), offers a means to conceptualise and investigate how pupils' internalised dispositions (*habitus*), access to various forms of capital, within the field of mathematics education collectively shape mathematical practices. While this theory has been widely used qualitatively (Reay 2004, 2017, 2020; Ingram, 2009, 2011; Friedman et al, 2015, 2016), there remains a significant gap in research that seeks to quantitatively operationalise these concepts, particularly Mathematical *Habitus,* as a starting point to measure the impact on practice.

This study responds directly to that gap. By focusing on *Mathematical Habitus*, the research aims to provide a quantitative approach to understanding how social and cultural factors influence pupils' *Mathematical Habitus,* which Edgerton *et al* (2012) suggests impacts educational practices and outcomes. Specifically, the research questions are designed to identify the key predictors of a stronger *Mathematical Habitus*, thereby offering insights into how we might better support pupils from diverse backgrounds. Given the role of mathematics as a gatekeeper to further education and future employment (National Numeracy, 2023), identifying these predictors is crucial for informing more equitable educational strategies and for challenging the factors that perpetuate inequality.

Through this approach, the study moves beyond deficit models of underachievement and towards a more holistic understanding of how mathematical success is socially shaped, offering both theoretical and methodological contributions to addressing mathematics inequalities.

Chapter 3: Methodology

This chapter outlines the epistemological and methodological foundations of the research, detailing the approach taken to investigate the socio-cultural factors influencing *Mathematical Habitus*. Guided by a Bourdieusian theoretical framework, the study aims to quantitatively measure *Mathematical Habitus* and identify key predictors that shape pupils' *Mathematical Habitus* and practices.

The chapter begins by discussing the epistemological underpinning of the research, critical realism, which acknowledges the interplay between structure and agency (Bunge, 1998; Scott, 2005; Williams, 2021) while seeking to measure their effects on *Mathematical Habitus* through empirical data. It then details the methodological process, including the development of the Harris Dispositional Framework and constructs to capture pupil attitudes, parent attitudes, peer attitudes, In-School and Out-School value, relevance, confidence and *Mathematical Habitus*.

A rationale is provided for the use of survey data and advanced statistical techniques including bivariate analysis, multivariate regression, structural equation modelling and multi-level modelling to explore relationships between variables. This research aims to offer a valid, reliable and theory-informed understanding of the complex factors that contribute to educational inequalities in mathematics.

Research Questions and Aims

Research Question 1

Can we quantitatively measure *Mathematical Habitus*?

Aim: To quantitatively measure *Mathematical Habitus* based on Bourdieu's Theory of Practice and a system of careers and its determinations model.

Objective: To assesses reliability and validity of multi-item scales designed to measure In-School value, Out-School value, relevance and confidence of mathematics.

Research Question 2

What factors affect pupils In-School value, Out-School value, relevance and confidence of mathematics?

Aim: To assess whether different factors increase or decrease pupils perception of the In-School value, Out-School value, relevance and confidence of secondary mathematics.

Objective: Use a series of bivariate tests (t-tests, Mann Whitney, ANOVA, Kruskal Wallis, Spearmans rho) and multi-linear regression to identify significant differences and relationships between independent variables and the In-School value, Out-School value, relevance and confidence of mathematics.

Research Question 3

What are the key predictors of a stronger *Mathematical Habitus*?

Aim: To assess what factors are the key predictors of higher *Mathematical Habitus*.

Objective: To conduct regression and multi-level models to identify the most significant factors of higher *Mathematical Habitus*.

Please see appendices for all hypotheses relating to the above research questions.

Introduction

Critical realism allows for the acknowledgement of the interplay between structure and agency; that society is a set of systems and individuals membership and relationships within those systems create two different relations; those that make a difference and those that do not (Bunge, 1998). Bourdieu's (1990) 'career and its system of determination model' provides a conceptual framework that incorporates the impact of demographics, socio-cultural factors and agents (parents, peers and teachers), alongside Bourdieu's (1977: 101) '(*habitus* x capital) + field = practice' formula that supports the operationalisation of these concepts using the Harris Dispositional Framework to measure *Mathematical Habitus*. Therefore, a critical realist lens will be applied to allow the theoretical framework of Bourdieu's theory of practice (1977) to be used as a guide to measure *Mathematical Habitus*.

Critical Mathematics Education researchers are concerned with the social and political aspects of learning, the use and function of mathematics in practice and in everyday life, and the need to talk about the issues within mathematics education such as the social background of children, the multilingual, the multicultural, the ideology of mathematics and the distribution of resources amongst different groups of students (Skovsmore and Borba, 2004). Therefore, critical realism lends itself well to this research as it understands that society is complex and the need to understand how relationships amongst different social factors can influence practices and outcomes (Sayer, 2000; Edgerton *et al*, 2013).

Critical Realism and Quantitative Methodology

From a critical realist standpoint, a quantitative methodology has been selected, as it seeks to bridge the gap between ontological realism (what exists) and epistemological relativism (how we come to know it) (Scott, 2005; Williams, 2021). Quantitative approaches such as complex regression analysis, multilevel modelling, and structural equation modelling are valuable tools for identifying patterns and relationships within society. However, critical realism also emphasises that variables are not direct reflections of reality, but are conceptual constructs shaped by the researcher's own reality and theoretical framing (Williams, 2021). As such, the gap between reality and knowledge cannot be entirely closed, though it can be narrowed through the careful selection of methods and rigorous analysis. Scott (2005) further argues that all attempts to describe and explain the world must be fallible, and the ways in which we define variables and model relationships must always remain open to critique and replacement by a different set of variables and relationships, acknowledging the provisional and evolving nature of understanding.

Sayer (2000) identifies objects that social scientist's study such as institutions, are a product of multiple components and forces that are always open and are usually complex and messy. He continues to acknowledge that unlike the natural sciences we cannot isolate the components and examine them individually. Instead, we must rely on the researcher's abstraction and conceptualisation of various components and influences and consider how they combine and interact in order to start to make sense of it. To do this would mean the appropriate methodologies need to be developed and used that allow us to understand the relationship between structure and agency (Scott, 2005). Another thing to consider is the way we measure the social world depends on how the researcher decides what factors could influence the object being studied. Nash (2002) suggests this should be backed up by theory, whilst identifying that this is also a problem as the researcher is also an agent of society who themselves are also constantly being influenced by their own surroundings and perceptions of the world. Therefore, the generation of knowledge is a human activity and depends on the models and methods used to understand it (Smith, 2006). Findings must come with the understanding that they were true at the time of data collection, but must be open to critique and replacement in the future (Scott, 2005).

Using quantitative methods for a sociological study has it challenges. Corson (2000) identifies that social systems are often complex and messy, with relationships between the cultural and the structural being dependent on a range of factors. However, despite these complexities, Corson (2000) acknowledges the importance of conducting research despite its imperfections as the way we construct the measurement of society can influence human behaviour that becomes real. For example, the construct of race allows societies to attach practices and behaviours to that construct that may have real effects on society (Bryant *et al*, 2022). Therefore, despite quantitative methods being seen as deductive by reducing a concept down to something that can be measured, it is equally as valuable as it allows us to identify structures that may have an impact on agents' behaviour. Especially in a society that is so complex, this contributes to our knowledge of society but also becomes the start for future developments and the opportunity for it to be changed. Sayer (2000) also emphasises that many kinds of social research operate within categories such as official statistics, even though they are based on 'bad abstractions', emphasising the idea that scientific knowledge is historically and politically imperfect (Smith, 2006). Williams (2021) is interested in the use of regression models that aim to explain an outcome by explaining as much of the statistical variance by fitting the independent variables to the model to give the best fit. This research aims to use factor analysis, regression, structural equation and multi-level modelling, as from a critical realist perspective, the combination of different types of methods and analysis allows us to better understand the outcomes of the research and narrow the gap between what is real and how knowledge is created (Williams, 2021; Scott, 2005).

Critical Realism in Critical Mathematics Education Research

Critical realism lends itself well to critical mathematics research as critical mathematics researchers are concerned with the social and political aspects of mathematics and emphasise the need to look at the cultural values, tradition, inclusion and exclusion of pupils within the realm of mathematics education. By taking inspiration from Bourdieu (1977, 1984, 1990) this research is also interested in looking into how pupils are excluded from mathematics education due to their social and cultural capital. Critical realists acknowledge the capability for agency to become structures, with critical mathematics researchers highlighting how social, cultural and economic structures can exploit those within the education system, and the need for research to help challenge and transform these structures and society. Skovsmore and Borba (2004) highlight that pupils should have access to a democratic experience of mathematics despite their race, gender and class; demographics that this research explores, alongside other social and cultural factors such as free school meal eligibility, English as an additional language and parent and peer attitudes, highlighting the complexity of influences on mathematics education. Through the use of statistical modelling, quantitative methods allows for these complexities to be explored.

Corson (1995) focuses on how social structures are important in building educational systems that are responsive to the needs of diverse student groups. Shipway (2010) adds that these structures may not always be positive due to them being in place for many years, whilst the agents (teachers, parents and pupils) are unaware they are recreating the structure through their actions and involvement within the education system. Treating social structures and mechanisms in education as real allows us to consider their effect in educational settings. As a result, critical realism is concerned with describing the power relations that emerge from these structures and social interactions (Shipway, 2010).

A key challenge for critical realists is understanding how wider social structures and mechanisms filter into the educational system, and how they influence classroom processes. A major task for critical realists is to untangle how wider structures filter into the education system, and then classrooms to recreate four things: ideology-producing classroom processes, instructional rather than educational action, supervisory rather than relational forms of interaction and a reproduction of unjust sociocultural arrangements (Corson,1998: 208).” Where within each of these they are clear winners and losers, that are almost the same people who start out from behind (Corson,1998). This will be used to apply a critical realist lens to this research to understand how knowledge gained is dependent on a system of societal structures.

Ideology-producing classroom processes

Mathematics has been a core subject since the Newcastle Report (1858), despite ongoing concerns regarding its irrelevancy to society (Tomlinson, 2004; Voderman *et al*, 2011; Gravemeijer *et al*, 2017; Hernandez-Martinez and Vos, 2018), growing attainment gaps (The Sutton Trust 2016, 2024; DfE, 2021) and lower international attainment levels (Mullis *et al*, 2020; Von Davier *et al*, 2024). The education system puts value onto the subject, which Pais (2013) refers to as like a credit system, the idea that by gaining a pass at GCSE mathematics will enhance social mobility. According to Jurdak *et al* (2016) the idea that pupils are told every day that they must do well in GCSE mathematics is an ideological illusion which helps to legitimise and maintain current social order. Many people do not go on to use mathematics they learnt at school in their everyday lives or careers (Young, 2022), therefore, to legitimise the value of the content being taught in the classroom, this ideology is used which teachers are aware of, to keep pupils focused on the content being taught (Jurdak *et al*, 2016). This research asks pupils’ perceptions of the In-School value, Out-School value and relevance of mathematics to explore whether there are differences between what they believe the mathematics curriculum to be useful for and how this impacts *Mathematical Habitus*.

Instructional rather than educational action (confusing ‘education’ with ‘instruction’).

Some scholars argue that education today is driven less by a commitment to genuine learning and more by a focus on 'teaching to the test' (Dorling, 2015). Pupils are primarily taught the skills necessary to pass exams aligned with the national curriculum, rather than being encouraged to develop as independent, critical thinkers. Recently, corporations such as Microsoft have even released white papers (2022) outlining what they believe schools should teach to prepare students for the future workforce. This raises important questions about the relevance of the current national curriculum, particularly in mathematics, to contemporary society. If teaching is narrowly focused on exam success, pupils may struggle to understand the real-world applications of what they are learning, such as algebra, and fail to see its value beyond the classroom. Consequently, this research seeks to explore pupils' perceptions of the relevance of mathematics in their daily lives, as well as their parents' views, in order to better understand how these attitudes may influence pupils' *Mathematical Habitus* and practices

Supervisory rather than relational forms of interaction (between teachers and pupils and parents and pupils)

Supervisory forms of interaction refer to those interactions that pupils have with those that have more authority over them, for example teachers and parents. This research is interested in how the interactions with these supervisory figures influence their *Mathematical Habitus,* alongside pupils and parents' demographics and parents and peer attitudes towards mathematics. Demographics, social and cultural capital and the impact of parents and peers are key to this research, therefore it is favoured that multi-level modelling will be used as it allows for the exploitation of the interplay between structure and agency on *Mathematical Habitus*.

Reproduction of unjust sociocultural arrangements

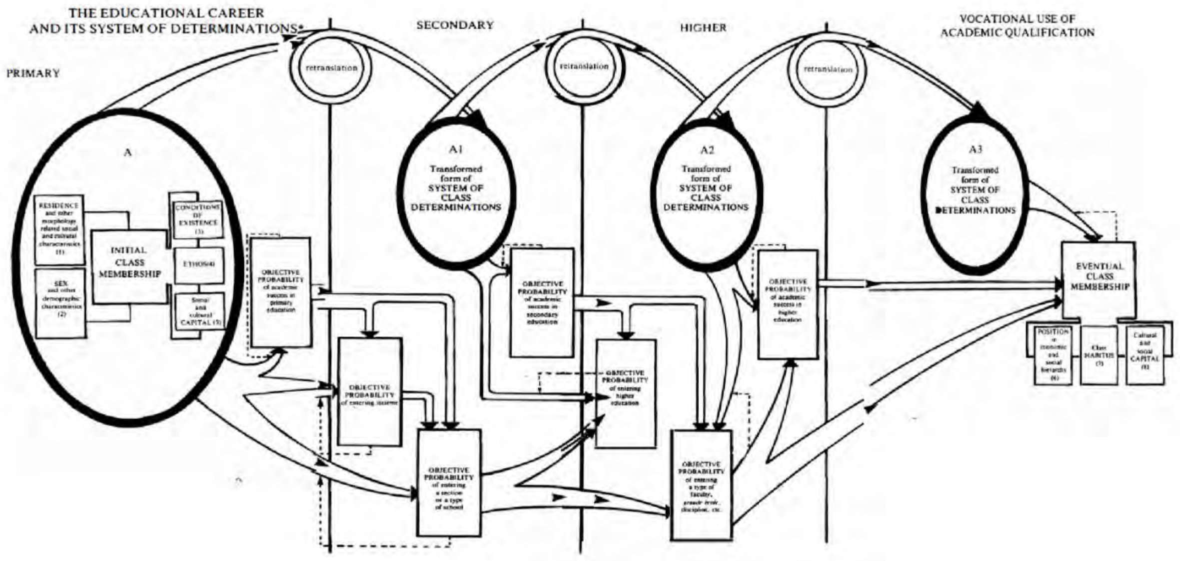
Underpinning this research is the reproduction of inequalities in education that is still seen today (The Sutton Trust, 2024; Farquharson, 2022; Hobbs and Mutebi, 2021). This research draws on Bourdieu's theory of practice, expressed through the formula '(habitus x capital) + field = practice' (Bourdieu, 1977: 101), to develop a model for exploring mathematical inequalities. Central to this model is the concept of an individual's *Mathematical Habitus*, which is shaped by their social and cultural capital and influenced by key agents such as parents, peers, schools, and teachers. These factors interact within the field of education, guiding how they impact pupils' mathematical practices (Edgerton *et al*, 2013). Corson (1998) acknowledges the use of Bourdieu's symbolic capital by explaining that schools present the interests of some groups norms and values as if they are universal interests of everyone. This suggests the importance of investigating social demographic characteristics to understand how these may impact on pupils' mathematical practices. This research uses a variety of quantitative analysis methods to create the Harris Dispositional Framework, that is used to identify key predictors of *Mathematical Habitus* that informs mathematical practices, informed by pupils' socio-cultural factors (Edgerton and Roberts, 2012).

Bringing Critical Realism, Bourdieu and quantitative methods together

Many argue that critical realism and Bourdieu do not work together as Bourdieu's theory of practice (1977) is very deterministic (Jenkins, 1982; Alexander, 1995 King, 2000). However, Bourdieu (1990) speaks of the many misunderstandings of his readings and the importance of empirical research to back up claims. In '*Reproduction in Education, Society and Culture'* (Bourdieu and Passeron, 1990), Bourdieu models the correlations between variables which demonstrates the impact of demographics, class, dispositions and capital on the reproduction of education from primary through to higher education.

Much of Bourdieu's work used in education is within the qualitative realm (Ingram 2011; Ingram and Abrahams, 2016; Reay, 2017), disregarding Bourdieu's use of empirical research and quantitative data analysis. However, a careful reading of '*Reproduction in Education, Society and Culture'* (1990), uncovers Bourdieu's frustration of the misunderstandings of his work due to the translation of his work that has not included the empirical research that underpins his work. Bourdieu asks for *Reproduction in Education, Society and Culture* to be read alongside many of his other works and for the empirical research to be noticed. However, despite this being written in 1990 and regarded as one of the most cited books, research dominantly continues to qualitatively use Bourdieu's concepts of *habitus*, capital and field. Here I draw particular attention to the preface of *Reproduction in Education, Society and Culture* (1990) and his 'the educational career and its system of determinations' diagram embedded within the appendices of the same book.

Figure 1: The Educational Career and its System of Determinations Model



This diagram shows Bourdieu’s thinking of how demographics, social and cultural capital alongside external influences can impact educational outcomes. Bourdieu (1990) explains the diagram is intended to suggest the logic by which the system of determinations attach to class membership, with circles A (figure 1) restructuring itself as a function of the varying weight of any given factor. Furthermore, Bourdieu acknowledges that the system of factors within these circles are constantly restructured, with the lines indicating correlations between variables and reproducing the *habitus*. This suggests that transformation of the *habitus* is possible and supports the use of structural equation, regression and multi-level modelling to evidence these changes due to the use of variables and correlation weightings that these data analysis techniques use. Furthermore, this research aims to evidence a measure of *Mathematical Habitus* using quantitative methods, that Bourdieu’s model of educational career and its system of determinations suggests is appropriate.

As a pupil progresses through their educational journey, this model suggests that there is a system of five factors that affect the *habitus* at each stage: residence and other morphology related social and cultural characteristics, sex and other demographic characteristics, conditions of existence, ethos and social and cultural capital. The table below evidences each of these and how the Harris measure of *Mathematical Habitus* incorporates similar measures, suggesting the robustness of the measure.

Table 1: Harris measure of *Mathematical Habitus* in relation to Bourdieu's Model

Bourdieu	**Bourdieu's explanation**	**Harris**
Residence and other morphology related social and cultural characteristics	Structure of academic and cultural groups belonged to (neighbourhood, peer group)	Peer attitudes towards mathematics, parents' attitudes towards mathematics
sex and other demographic characteristics	Other demographic factors	Demographics – gender, ethnicity
Conditions of existence	Security of employment, working conditions and environment etc.	N/A
Ethos	Dispositions towards school and culture etc.	In-school value, out-school value, relevance and confidence
Social and Cultural capital	Linguistic capital, capital of social connections, prestige and information on educational system etc.	Speaking English as an additional language, parents' attitudes towards mathematics, peer attitudes towards mathematics

Demonstrated within the theoretical framework of this work, later developments of Bourdieu's work (1990, 1992) suggest a reflexive *habitus* that fits well with the epistemological underpinnings of critical realism that understands the reflexive nature of research to change as new developments are made (Scott, 2005). Bourdieu (1990) acknowledges that analysis that has reduced the complexity of the education system has led to misunderstandings that reproduction occurs without transformation that excludes all opportunities for change. Decoteau (2015) believes change is always possible due to the agent always being situated within the intersection of multiple and competing positions where disjuncture's can arise and influence the *habitus*. Furthermore, the notion that reality is a complex system that is messy and always open to change, (Barrett *et al*, 2013; Sayer, 2000), similar to how Bourdieu explains *habitus* as a 'complex system that is relational'

(Bourdieu and Passeron, 1990). With Bourdieu highlighting the importance for empirical evidence to be used, and the frustration which many of his translations do not include, suggest that Bourdieu, Critical Realism and quantitative methods can and do work together. They have common goals to analyse the complexity of society through a variety of methods, producing empirical evidence to acknowledge that evidence is true at the time of the data collection with the possibility for it to adapt in the future. Furthermore, there is also agreement that research should be for the good of those being researched; to help uncover inequalities in society and to help those being researched to shed light on the situation as a step to overcome any difficulties they may face in society, with Bourdieu (1984) recognising that a number of official criteria in fact serve as a mask for hidden criteria, therefore highlights the need for enquiry behind variables we take for granted and favours complex statistical analysis.

Burke (2016) uses Bourdieu's theory of practice (1977) and believes through creating a map of social space, we can begin to see patterns where large numbers of individuals share a similar position, leading to the formation of social groups based on similar levels of capital and attitudes. This formation of large numbers gives recognition that amongst the complexity of the social world, quantitative analysis can be used to address patterns that are at least a starting point for future developments.

Much research using Bourdieu's concepts of *habitus*, capital, field and practice are more evident within the realm of qualitative methods (Edgerton and Roberts, 2014). Much research within the quantitative realm measures objectified cultural capital and uses many different interpretations of *habitus*. For example, Quaye (2014) uses an 11-point *habitus* scale when researching the impact on mathematical attainment that relates to career aspirations. However, research suggests that there is much more to *habitus* than career aspirations (Bourdieu, 1977; 1984; Ingram and Abrahams, 2016), and instead there is the need to measure social and cultural factors alongside pupils' demographics and the influence of parents, peers, teachers and schools.

Bourdieu's work in *Distinction* (1984) where he most fully demonstrated his work of *habitus* is based on correspondence analysis that is a statistical method used to observe similarities and differences between variables. It has some similarities to factor analysis that it produces a set of orthogonal vectors to locate different categories in multidimensional spaces. Unlike factor analysis which reduces complexity to form categories, correspondence analysis determines complexity but does not hold any inferential statistical power (Cockerham and Hinote, 2009). Cockerham and Hinote (2009) go on to explain that:

"Figures 11 and 12 in Distinction (p262), Bourdieu plots the spatial distributions of the economic and cultural capital of his survey respondents through the distribution of cultural preferences…in relation to various occupations and professions" (2009; 205).

This provides evidence of Bourdieu's use of quantitative analysis to map respondents' capital in relation to their careers. This supports the use of quantitative methods in this research as the aim is to use regression, multi-level and structural equation modelling that incorporates social and cultural capital to produce a starting point of measuring *Mathematical Habitus* and its impact on mathematical practice.

The following section outlines the methodological approach adopted in this study. It will detail the design of the survey, describe the steps taken to ensure rigor and validity, and discuss the ethical considerations carefully addressed throughout the research process. This overview aims to provide a clear understanding of how the data was collected and analysed to explore pupils' and parents' perspectives on the value and relevance of mathematics, leading to the construct of *Mathematical Habitus.*

Ethical Considerations when researching children

Conducting research with children requires careful attention to a range of ethical considerations. Central to this is ensuring that the research is meaningful to the child and does not cause harm (ESRC, 2024). Ethical concerns such as power dynamics, potential bias, informed consent, and the need for child-friendly approaches must still be addressed (Cohen *et al*, 2017; BERA, 2024). The research design has been informed by these considerations. Age appropriate, accessible language was used in all questionnaires, and data collection methods were chosen to support understanding and engagement from the child participants. Care was also taken to minimise researcher bias, that will be outlined in upcoming sections, ‘questionnaire design’ and ‘administering the questionnaire’.

The issue of consent is particularly important. Informed consent was obtained from gatekeepers such as head teachers and head of departments who act as responsible adults in school settings. Recognising the power dynamics at play between adult researchers and child participants, steps were taken to empower the children to participate voluntarily and to withdraw at any time without consequence. Additionally, a Disclosure and Barring Service (DBS) certificate was obtained to ensure the safety of the children and to demonstrate the researcher’s suitability for working in educational environments.

Each school gave devolved consent which is common practice in educational research. The British Education Research Association (2018) identify that:

“Institutional leaders may agree to take part, acting as gatekeepers on behalf of members (such as teachers and students in schools). In order to ensure that all participants are as fully informed as possible about the costs and benefits of the study, researchers should offer both information and support. This may result in participants exercising their right to opt out within the parameters of the intervention.”

This research sought ethical approval through the Manchester Metropolitan University ethical committee under the conditions that written informed consent was given to all participants and parents prior to the research being carried out.

Questionnaire Design

Prior to survey design, there are numerous things that should be considered such as the length of the questionnaire, the types of questions asked, how questions are measured, time taken to fill on the questionnaire and how the survey will be delivered (Allen *et al*, 2021). These considerations when designing this survey will be discussed to ensure it is appropriate for the participants and aims to address the research questions.

Surveys are one of the most frequently used methods in educational research due to their cost and time efficiency that also allows for shy respondents to answer questions in private (Menter *et al*, 2011). If designed well, questionnaires can generate large sample sizes, therefore inspiration was taken from Cohen *et al* (2017) for the design of the questionnaire for this research to yield a large sample size to generate reliable results. Large sample sizes are important as a critical realist to capture the complexities of society, but also as a quantitative researcher to allow for complex statistical analysis and valid and reliable measures and findings to be generated. Denscombe (2014 cited in Cohen *et al*, 2017) highlights that having a questionnaire that is too long can lead to respondent fatigue and if it requires too much effort students will not take part, with DfE guidelines (DfE: online) recommending that when researching with children, to align expectations with the national curriculum to make sure that the child's understanding of the question is appropriate to that level of study. For example, this research focuses on Year 9 pupils that are aged 13-14 years old to reflect the age range surveyed in TIMSS and PISA analysis. Therefore, the national curriculum provides an outline of what pupils should understand at each level that measures their readiness to progress onto the next stage. The Key Stage 3 mathematics national curriculum serves as a guideline for this research when asking participants about their confidence in each mathematics topic. The national curriculum outlines what Year 9 pupils are expected to understand at that point in their schooling through their engagement with the education system. Child-friendly language was also used to ensure pupils understood the question. These factors ensure questions are relevant to the pupil that enhances the reliability of any data collected.

To enhance response rate, Allen *et al* (2021) suggests using clear instructions, short questions and to make consistent use of any scales and formatting to allow participants to flow through the questionnaire more easily. This encourages the participant to complete the questionnaire and leads to higher response rates and high-quality data. With this, the research questions and purpose of the research in mind, closed questions are favourable as they provide categories that makes the questionnaire quick to complete but is also useful for statistical analysis that allows for comparisons between groups (Oppenheim, 1992:115 cited in Cohen *et al*, 2017). Furthermore, Likert scales are used as a reliable way to measure attitudes (Likert, 1932). Likert scales help capture attitudinal data as it forces the respondent to give an opinion, but also allows for the reliability of the data to be tested using Cronbach's Alpha and Exploratory Factor Analysis (EFA) (Batterton and Hale, 2017). This provides a consistent and reliable way to measure attitudes, that aligns with the theoretical framework of Bourdieu's Theory of Practice (1977) that allows for quantitative analysis to be carried out to provide a way of quantitatively measuring *habitus*. Inspiration is also taken from previous research that's measures attitudes with children using Likert scales (Massey, 2019; Hunt *et al*, 2011). These studies found Likert scales to be valid, reliable and appropriate measures when researching with children due to their clear and consistent design.

Acknowledging the limitations of cross-sectional data

Although the questionnaire was carefully designed to ensure high levels of reliability and validity, it is important to acknowledge a key limitation of the research design: the use of cross-sectional data, collected at a single point in time. This means the data reflects only a snapshot of participants' experiences and attitudes, without the ability to track changes over time (Wang and Cheng, 2020). As such, factors such as the time of the school day, current curriculum topics, or even a student's mood on that particular day may have influenced responses. While the study aims to capture broader patterns, it is possible that some findings may reflect temporary conditions rather than long-term attitudes and dispositions.

Access and recruitment

Accessing schools, pupils and parents is key for this research to be successful, but also comes with its challenges. Cluster sampling was used due to it being the most appropriate technique to gain a large sample size whilst acknowledging difficulties gaining access to schools. Cluster sampling is common in educational research due to schools being able to provide devolved consent to large groups of pupils that result in large sample sizes adequate for complex statistical analysis (BERA, 2018). This also reflects to be most appropriate for multi-levelling modelling to analyse the impact of the school on pupils *Mathematical Habitus*.

Accessing Schools

Accessing participants for educational research is a key challenge due to the safeguarding of pupils and the inconvenience of adding to the workload of teachers that are already stretched, and the research taking away from pupils' class time and routine (NSPCC, 2023). Therefore, to overcome these challenges, the researcher used their own social capital and networks to gain access to schools and a gatekeeper that opened up more opportunities of school for the research to take place. Pursuing Individual Excellence (PIE) is an educational social enterprise focused on making sure that pupils' backgrounds do not limit or influence their future opportunities. They offer several programmes within schools, primarily focused around increasing the social capital of the students they work with to develop skills that will give them a fairer chance at future opportunities. The researcher has, and continues to work with PIE for 6 years, that agreed to act as a main gatekeeper to access schools for this research. PIE have connections with numerous schools around the North West. The founder informed their connections with these schools about this research by a template the researcher created that provided an outline of the study, the opportunity for the teachers to get in touch with the researcher if it is something they will be interested in, and an incentive of extra maths tuition for those that may need it due to the researchers teaching experience and PGCE in Secondary Mathematics, or a university style workshop for the school with any year group they may think will benefit to give the opportunity to ask questions about university. This process provided crucial to gain access to a large sample and lead to access to a further 3 schools in this sample.

Other schools in the sample were recruited at a teacher job fair held at Manchester Metropolitan University where the researcher went along to speak to the headteachers about the research. Email addresses were collected and followed up which got access to a further 2 schools. The final mode of school recruitment was contacting an old Sociology teacher to tell her of the PhD research and opportunity for the school to take part. This led to a total of 10 Secondary schools in North West England ,1759 year 9 pupils, 341 parents and 62 maths teachers. This provides adequate sample size for multivariate analysis.

Although a successful sample size, the researcher acknowledges that social capital has a huge part to play in the recruitment of schools, and it is likely that those who agreed to take part in the research were those that are proud of their progress in mathematics. However, due to the difficulty in accessing schools, this serves as an indicator of what is happenings amongst some of the Year 9 cohort in the North West. The demographic of each school cohort will be analysed and compared to that of the general Year 9 cohort in the UK.

Research Sample

The sample used in this study is best characterised as a cluster, non-random sample. Participants were recruited through schools that were purposefully selected based on accessibility and willingness to participate, rather than through random sampling procedures. This approach reflects the practical constraints commonly encountered in educational research, particularly those required to gain institutional access. Participants are therefore clustered by school, and the sample is shaped by institutional access, rather than by probabilistic selection. This has implications for generalisability, as the sample may not be representative of the broader student population.

The majority of the schools involved were part of the PIE programmes, which specifically targets students from socially disadvantaged backgrounds. As a result, the sample is expected to reflect higher levels of socioeconomic deprivation.

In terms of data quality, missing data accounted for less than 10% across all variables in the sample (see Appendix D). This is considered acceptable and suggests a relatively high level of data completeness (Bennett, 2001), despite the challenges of conducting research in school settings.

Year 9 students were selected as the target cohort for this study due to their alignment with international benchmarking assessments such as TIMSS and PISA, which informed both the initial research interest and related policy developments in mathematical mastery. Practical considerations also influenced this choice; Year 9 students were more accessible than those in Years 10 or 11, who were typically engaged in intensive GCSE examination preparation.

Accessing Parents

Accessing parents was crucial for this research and is often described as difficult, especially amongst those ‘hard to reach parents who lack engagement with schools (Campbell, 2011; Boag-Munroe and Evangelou, 2012). To overcome this, three main methods were used. The first was that the researcher attended Year 9 parents’ evenings and distributed the questionnaire to parents as they came into the school and were waiting to see teachers. The second was that the researcher attended Year 9 options evenings where they walked around and asked parents if they had a spare 2 minutes to complete the questionnaire. These two methods provided the most successful and where majority of respondents were recruited and to try and minimise disruption at these events, a box was placed in the room that parents were asked to place the questionnaire once completed. During the time of data collection, it occurred that some schools had already had their parents and option evenings therefore there were no opportunity to gain face to face contact with parents. Instead, an online version was created and sent to parents via text message or email by the school to try and increase response rates. Menter *et al* (2011) highlights the importance of an incentive to increase response rate, therefore due to the lack of parents' data and participation in school activities (Education Endowment Foundation, 2021) the decision was made to advertise to parents that by completing the questionnaire they would be entered into a prize draw to win a £50 Amazon voucher by providing their email address.

Similar to the administration of the pupil questionnaire, the researcher was present when collecting data from parents at parents' evenings and option evenings that allowed for the researcher to explain the reason for the study and was present in case any parents needed anything clarifying. Parent questionnaires also had a research booklet cover with the information regarding the research that also acted to maintain confidentiality and anonymity. However, in the schools where the questionnaire was administered online via text or email, this was not possible. A combination of access and recruitment strategies yielded a response rate of 341 parents.

Pilot study

Piloting a questionnaire is crucial to increase the reliability and validity of the measures, but also to gain feedback on the practicality of the questionnaire and to identify any misunderstood or complex questions (Oppenheim, 1992, cited in Cohen *et al*, 2017). The pilot study was conducted using a smaller subset of target respondents which the researcher gained access to via their involvement of a PIE programme. PIE contacted the headteacher of the school with the researchers' details where they signed a consent form allowing the pilot study to be completed in the PIE future ready session with a group of their year 9 pupils. In total, there were 28 pupils that completed the questionnaire under similar conditions than that of the main survey (Menter *et al*, 2011). Once all pupils had completed the questionnaire, the researcher took the opportunity to clarify the pupils understanding of some terms such as free school meals and English as an additional language to ensure that the pupils understood what was being asked of them. Pupils were told of the importance of the research and their role in piloting the questionnaire to make sure their understanding was correct before it was rolled out across other schools in the North West. Therefore, they were asked for their honest opinion whether they understood it or found any questions difficult to complete, where no suggestions were made. The time it took pupils to complete the questionnaire was monitored with most pupils completing the questionnaire in under 10 minutes.

The research also wanted to give the opportunity for pupils to have input into the design of the questionnaire. Pupils were asked whether there was anything that they would not include or anything they would change. It became apparent that some pupils at that school had two different maths teachers – one male and one female. Therefore, this option was added to the final questionnaire when asking for teachers' gender. Other than this, all pupils seemed satisfied with the design of the questionnaire and what was being asked of them. Although, the researcher acknowledges that there are still power dynamics in this process as research was conducted in a classroom that ties with connotations of traditional power dynamics where the teacher has the authority and holds all knowledge, and pupils are the learners (Symonds, 2021). Students may not have felt comfortable to tell the researcher of anything they could not understand. However, these power dynamics come into play each time a pupil is in the classroom and are true of all research in schools, therefore the decision was made to continue with data collection once the change to the teacher gender question was made.

Once the data was collected, it was imported into SPSS to check for the reliability and validity of the measures. It is important to ensure the reliability of the attitudinal statements being asked, therefore a Cronbach's Alpha reliability check was conducted on statements that were positively and negatively worded to ensure that pupils were answering the questions correctly. Cronbach's Alpha was done on the variables; 'I like maths', 'I don't like maths', 'Maths is easy', 'Maths is hard', 'I enjoy maths when in class' and 'Maths is boring'. Cronbach's Alpha indicated high reliability of these statements at a score of 0.914. Anything above 0.7 is accepted (Cronbach, 1951). Descriptive statistics were also produced to see whether pupils were distinguishing the difference between the value and relevance of different topics in mathematics. Unfortunately factor analysis was not appropriate as it requires a sample size of 50 or above to be reliable (de Winter *et al*, 2009).

The decision was taken not to pilot the teacher and parent questionnaire due to the difficulty in getting access to these groups. Instead, it was sent to teachers the researcher had access to through PIE for their feedback. All feedback was positive, and no changes were needed.

Administering the Questionnaire

Administering the questionnaire is a carefully considered design and comes with caution, as the researcher must think about response bias, response rate, socially desired responses, validity, reliability and cost (Bryman, 2012). Prior to the researcher conducting research, schools obtained devolved consent on behalf of the pupils that was approved by the headteacher or head of mathematics (see appendix A). It was requested by the researcher that schools would inform parents about the research being carried out and send the information sheet at least 2 weeks before the research was carried out that outlined the purpose of the research, the opportunity to opt their child out of the research and, contact details if they had any questions. Schools were reminded by the researcher to send this information and were asked to email confirmation that this had been done.

Many disadvantages affiliated with questionnaires can be partly overcome by administering the questionnaire face to face (Menter *et al*, 2011) as it allows the researcher to take control of the environment and enforce that the research is being carried out correctly. Pupils were provided with an information sheet that was purposely written in simple language so that the child could understand the purpose of the research and what they were being asked to do. This was presented as a research helper booklet that gave clear guidance to the pupils what were expected of them, but also acts as a way of confidentiality; to conceal pupils responses to their peers, teachers and researcher to minimise bias. It was ensured that the researcher was always present during data collection, so they were able to give clear instructions to the pupils and clarify any misunderstandings, tell students the purpose of the research, that it is anonymous and were encouraged to read the information booklet and ask any questions before they completed the questionnaire.

Another key purpose for the researcher being present was to develop a rapport with students that is distinct from a traditional teacher to breakdown classroom norms that could influence the data collection (Strange *et al*, 2003), although the acknowledgement here that this can also result in bias and persuade the pupil to complete the research due to power dynamics still being present. The researcher clearly distinguished the difference between them and the teacher in attempt to reduce any power relations by identifying themselves as an outsider by giving their first name to pupils, and told pupils that they had the right to not complete the questionnaire if they did not want to. This breaks the traditional classroom norms as any adult is usually referred to by their surname and work in the classroom is usually compulsory. To reduce the likelihood that pupil' responses were influenced by those around them and to increase the confidentiality of students' responses, it was emphasised by the researcher that pupils must complete the questionnaire on their own and be honest as it is an important piece of research and is anonymous. The research booklet also helped with this, and with the researcher being present, it allowed the pupils clarify anything they were unsure of to enhance the validity and reliability of the results that pupils understood what was being asked of them. Although all efforts were made to distinguish this research from the school context, students are still likely to view the questionnaire as schoolwork (Denscombe and Aubrook, 1992). This combination of the researcher being present and the use of the information booklet allowed for less response bias, more accurate responses and less pressure for pupils to fill out the survey as it ensured anonymity and participant control if they did not wish to respond. This achieved a high response rate and fewer incomplete responses to gain a total of 1759 responses.

One advantage of administering questionnaires within schools is the ease of the questionnaire to be completed during class time that reduces time constraints which usually is a barrier to data collection (Strange *et al*, 2003). As the research focus is mathematics education, prior to data collection, communication was targeted to maths departments in schools as they are more likely to see the importance of the research, which also gained access to mathematics classroom to conduct the research. The data collection took approximately 10 minutes for the researcher to explain why they were there, the purpose, the pupils' rights and competition of the questionnaire. As most year groups were timetabled for mathematics on the same day, this meant that data collection only required one visit to the schools and for those students that needed more time to complete it, the teacher was flexible in allowing the students to continue the questionnaire and for the researcher to 'mop up' any that needed extra time at the end of the lesson.

Pupil Questionnaire

Table 2: Pupil's Questionnaire overview

Categories	**Variables**
Demographics	Gender Ethnicity Free School Meal eligibility English as an additional language Extra maths tuition Parents help with homework Maths teacher gender How well are you doing at maths
Confidence	On a scale of 1-5 how confident do you feel with the topics below Number Algebra Ratio, proportion and rates of change Geometry and measures Probability Statistics
In-School value	Learning (maths topic) will help me to pass my exam
Out-School value	Learning (maths topic) will give me more career opportunities
Relevance	I will use (maths topic) in everyday life

Peer influence	My friends like maths My friends this maths is important My friends think maths is boring My friends do maths outside of school
Attitudes	I like maths I do maths at home Maths is hard I am good at maths I do not like maths Maths is easy I need GCSE maths to get a good job I think maths is important I enjoy maths when in class I like my maths teacher GCSE maths is relevant to everyday life Maths is boring

Parent questionnaire

Table 3: Parents Questionnaire overview

Categories	**Variables**
Demographics	Parent/ guardian Gender Ethnicity English as an additional language Child's Free School Meal eligibility
Childs maths experience	Extra maths tuition Help with homework

Attitudes	I liked maths at school I did maths at home Maths was hard I was good at maths I did not like maths Maths was easy I liked my maths teacher GCSE maths is relevant to everyday life Maths was boring I use the maths I learnt at school in everyday life Getting GCSE maths has opened up more career opportunities for me
Maths knowledge	I know how GCGE maths is graded It is essential for my child to get a grade 4 or above in GCSE maths
Dislike of maths	I avoid working with numbers as much as I can Have you ever been in financial difficulty?

Measurement

This section introduces the measures used in this research. This includes pupils' attitudes towards mathematics, peer attitudes towards mathematics, parent attitudes towards mathematics, in-school value, out-school value, relevance, confidence and *Mathematical Habitus.* This section also addresses critique of using free school meal eligibility for a measure of social class.

Measuring free school meal eligibility

Free School Meals (FSM) eligibility is widely used by government bodies and educational researchers as a proxy for socio-economic status, particularly in the context of measuring disadvantage and educational inequality. While FSM is not a direct measure of social class, it is often employed due to its administrative availability and its correlation with parental income (Taylor, 2018; Campbell and Cooper, 2024). As such, FSM status provides a practical, albeit imperfect, indicator of social deprivation.

However, the use of FSM as a proxy for class is increasingly critiqued for its conceptual and methodological limitations (Jerrim, 2021; Campbell and Cooper, 2024). One of the primary concerns is its fragility and oversimplification. FSM eligibility is typically recorded as a binary variable (eligible or not), which fails to capture the complexity and fluidity of socio-economic conditions (Taylor, 2017). In today's volatile economic climate, families may experience rapid changes in income due to job loss and inflation This means that individuals from predominantly middle-class backgrounds may temporarily qualify for FSM, despite retaining significant forms of social and cultural capital. In contrast, children who have consistently been eligible for FSM often face deeper, more entrenched forms of disadvantage that FSM status alone cannot fully represent (Hobbs and Vignoles, 2010; Ille *et al*, 2017).

This distinction is critical. As Bourdieu's theory of capital suggests, social class is not solely determined by income but also by access to cultural, social, and symbolic resources (Bourdieu, 1986). A middle-class family experiencing short-term financial hardship may still possess educational qualifications, professional networks, and cultural knowledge that buffer the effects of economic deprivation. Conversely, a child from a persistently low-income background may lack these forms of capital, resulting in compounded educational disadvantage. FSM status, therefore, risks conflating these distinct experiences under a single label of "disadvantage", and as a result fails to account for the multidimensional aspects of deprivation (Ille *et al*, 2017).

Despite these critiques, FSM remains a useful indicator in educational research and policy. Its widespread availability in administrative datasets allows for large-scale analysis and targeted interventions (Ashraf *et al*, 2021; Gorard, 2013; Shackleton *et al*, 2018). However, researchers and practitioners must interpret FSM data with caution, acknowledging its limitations.

In the context of this thesis, FSM is used as one lens through which to examine educational inequality. However, the analysis also considers broader forms of capital and *habitus*, recognising that socio-economic disadvantage is a complex and layered phenomenon that cannot be fully captured by FSM status alone.

Measuring attitudes

Attitudes towards maths are predispositions to think, feel, perceive, and behave towards mathematics (Jovanovic and King, 1998). According to Burke (2016) *habitus* and capital contain particular attitudes that are strongly related to social and contextual factors such as values, habits and social norms (Carrasco and Lucas, 2015). *Habitus* and capital have a role in directing practices, therefore it is important to understand how attitudes can form part of our embodied capital, but how attitudes can also become part of the *habitus* in the form of dispositions.

Attitudes are commonly measured through Likert scales and are commended due to their good reliability and validity (Hunt *et al*, 2011). This measure uses Massey's (2022) measure of children's attitudes to mathematics and included all 6 of the original statements (I like maths, I do not like maths, Maths is hard, maths is easy, maths is important, and I enjoy maths when in class) that proved to be a reliable and valid measure when researching primary school aged children. Factor analysis was conducted to see whether this was also an accurate measure with secondary school pupils. The KMO and Bartlett's Test of Sphericity gave a value of .745 that indicates the sample is adequate enough for factor analysis. As the first factor correlation matrix using oblimin rotation shows values above 0.4 (Appendix C.1), this indicates that some items are measuring the same factor. Therefore, varimax rotation was used as this method of rotation assumes factors are not correlated (Massey, 2019). The factor matrix identified two factors being measured.

Table 4: Factor Analysis output for Massey's (2019) measure of pupils' attitudes towards mathematics

Variables	Factor 1	Factor 2
I like maths	.885	
I do not like maths	-.669	
Maths is easy		-.674
Maths is hard		.948
I think maths is important	.554	
I enjoy maths when in class	.817	

In the Harris measure of pupils' attitudes towards mathematics, two of Massey's (2019) statements to measure behavioural attitudes towards mathematics were added ('I am good at maths' and 'I do maths at home'), but adapted to add three extra statements due to common things the researcher heard whilst being a teacher. These were 'maths is boring', 'I like my maths teacher' and 'GCSE maths is relevant to everyday life' that aimed to capture the common statements made by children of 'what is the point in this?' and 'I'm never going to use this in real life'.

Harris measure of pupils' attitudes towards mathematics

The table below shows the factor analysis for the Harris measure of attitudes towards mathematics. This provides evidence to suggest that the statements use lend themselves to four factors within attitudes towards mathematics which highlights the complexity of the measure. In Massey's (2019) measure of attitudes towards mathematics he found there were two different subgroups of attitudes; emotional and behavioural. This research suggests there are four subgroups that I refer to as: emotional, perceptions of ability, importance of mathematics and feeling towards mathematics.

Table 5: Factor analysis for Harris' measure of pupils' attitudes towards mathematics

Variables	Factor 1	Factor 2	Factor 3	Factor 4
I like maths	.468			
I do not like maths	-.898			
Maths is easy		-.909		
Maths is hard		.774		
I think maths is important			.745	
I enjoy maths when in class				.697
I am good at maths		-.546		
I do maths at home				
Maths is boring				-.658
I like my maths teacher				.633
GCSE maths is relevant to everyday life			.668	

Reliability of measure

Results from the Cronbach's Alpha (.719) indicates that all 11 statements are a reliable measure of pupils' attitudes towards mathematics as it is above the threshold of 0.7.

Table 6: Reliability and measure of central tendency for Harris' pupils' attitudes towards mathematics measure.

Reliability	.719
Mean	34.38
Median	35.00
Mode	36.00
Minimum	11.00
Maximum	53.00

Table 6 shows that pupils' attitudes towards mathematics ranged on a scale between 11 and 53, with 11 indicating negative attitudes towards mathematics, and 53 indicating positive attitudes. The higher the figure, the more positive the pupils' attitudes towards mathematics. The average value was 34.38, the median 35 and the mode 36. Due to these figures being so close together, it indicates the data is normally distributed, with fewer pupils having very negative or positive attitudes towards mathematics.

The aim is to also measure parents and peers' attitudes towards mathematics, therefore these statements were adapted to be relevant to parents and peers to measure their attitudes towards mathematics.

Validity of the relationship between pupils' attitudes and dispositions towards mathematics

A series of bivariate tests were conducted across all four dependent variables to check for the validity of pupils' attitudes towards mathematics and the relationship between attitudes and dispositions.

Table 7: Bivariate analysis findings for pupils' attitudes towards mathematics and each mathematical disposition.

	Correlation coefficient	**Significance**
In-School Value	.178	<.001
Out-School Value	.294	<.001
Relevance	.345	<.001
Confidence	.433	<.001

Table 7 shows the correlation between each of the four mathematical dispositions and pupils' attitudes towards mathematics, identifying a relationship between attitudes and dispositions. The series of spearman's rho tests identified that there was a positive, significant relationship between pupils' attitudes towards mathematics and pupils' disposition towards their In-School Value, Out-School Value, Relevance and Confidence of Mathematics. Furthermore, table 7 indicates that confidence is most highly correlated disposition (.433), followed by relevance (.345), Out-School Value (.294) and then In-School Value (.178). This provides evidence to suggest that attitudes and dispositions positively correlate, therefore an increase in pupils' attitudes increases pupils' dispositions towards mathematics. This is supported by Thurstone (1928 cited in Fishman *et al*, 2021) that suggests a link between attitudes and dispositions as attitudes are the learned predispositions that incorporates beliefs and feelings towards the subject whereas dispositions are the internalised set of beliefs and values that shapes an individual's actions (Bourdieu, 1977). This is further supported by Beyers (2008) that suggests the ability of attitudes that are influenced by an individual's position in the social structure to become dispositional which impacts behaviour.

Although conducting bivariate analysis does suggest that attitudes and dispositions are independent of one another, when conducting regression analysis any variables that are correlated can cause issues of multicollinearity which can lead to unreliable regression models and findings (Field, 2018). Therefore, due to this close relationship between attitudes and dispositions, especially as both measures are from the pupil, the decision was made to not use this variable in analysis.

Positive parent attitudes

Parent influence was measured by asking parents about their attitudes towards mathematics at school, whether they believe it is relevant and whether maths has opened more career opportunities for them. Six statements were chosen that were positively worded that I believe captured what I was trying to measure.

Factor analysis was conducted to ensure the validity of the measure. The correlation coefficients outputted high values (Appendix C.3), indicating that the items correlate with the factor being analysed. As I am testing this measure for the first time, principal axis factoring was used. The KMO and Bartlett's Test of Sphericity gave a value of .767 (Appendix C.3) that indicates the sample is adequate enough to conduct factor analysis. Like the measure above, I took Joliffe's (2005) recommendation of extracting eigen values greater than 0.7 to reduce the amount of variance and to make sure the correct number of factors were measured. As the first factor correlation matrix using oblimin rotation shows values above 0.4 (Appendix C.3), this indicates that some items are measuring the same factor. Therefore, varimax rotation was used as this method of rotation assumes factors are not correlated (Massey, 2019). The factor matrix identified two factors being measured.

Table 8: Factor Analysis output for parents' attitudes towards mathematics.

	Factor 1	**Factor 2**
I liked maths at school		.700
I was good at maths at school		.875
Maths was easy		.897
GCSE maths is relevant to everyday life	.929	
I used the maths I learnt at school everyday	.929	
GCSE maths has opened up more career opportunities for me	.706	

This provides evidence that this measure is measuring two things: attitudes towards maths when at school and the value and relevance of mathematics. Although taken from inspiration from the pupil measure to measure value and relevance separately, when trying to encapsulate the differences between this when asking parents, it proved to be difficult as the statement is asking about their career which they are already in, whereas pupils are not in the stage of life yet, indicating the importance of language as we get older the value we place on things can become relevant to our everyday life. However, these two factors will be computed into one variable under the umbrella of parent positive attitudes towards mathematics.

Reliability of parents' measure

Table 9: Reliability and measures of central tendency for parents' attitudes towards mathematics measure.

	Parents attitudes
Reliability	.854
Mean	14.22
Median	14.00
Mode	13.00
Minimum	6.00
Maximum	24.00

Table 9 shows that the Cronbach's Alpha score (.854) indicates that all six statements are a reliable measure of parent attitudes towards mathematics as it is above the threshold of 0.7 (appendix C.3). Table 9 also shows that parents' attitudes towards mathematics ranged on a scale between 6 and 24, with 6 indicating more negative attitudes towards mathematics and 24 indicating more positive attitudes towards mathematics. The average value was 14.22 the median 12 and the mode 13. Due to these figures being so close together, it indicates the data is normally distributed, with fewer parents having very negative or positive attitudes towards mathematics.

Peer attitudes measure

Peer influence was measured by pupils perceived attitudes towards mathematics of their friends. Perceived attitudes were important as it is what we think of others, rather than what they actually think that influences our behaviours (Pickens, 2005). Therefore 4 statements were asked, these were: my friends like maths, my friends think maths is important, my friends think maths is boring, my friends do maths outside of school. To ensure the reliability of the measure, a Cronbach's Alpha test was conducted that indicated that peer influence is not a reliable measure when all

4 statements were included, however if the statement ‘my friends think maths is boring’ was deleted, the Cronbach’s Alpha score would increase.

When deleting ‘my friends think maths is boring’, these gave a reliable measure (.718) of peer influence as the value is above 0.7. Although this indicates that if the statement ‘my friends do maths outside of school’ was deleted the Cronbach’s Alpha would increase even more, the choice was to not do this as reducing the number of statements can reduce the Cronbach’s Alpha score and .718 is already adequate enough to ensure reliability (Tavakol and Dennick, 2011).

Table 10: Reliability and measures of central tendency for peers’ attitudes towards mathematics measure.

	Peer attitudes
Reliability	.718
Mean	5.41
Median	5.00
Mode	3.00
Minimum	3.00
Maximum	12.00

Table 10 shows that peers’ attitudes towards mathematics ranged on a scale between 3 and 12, with 3 indicating more negative peer attitudes towards mathematics, and 12 indicating more positive peer attitudes towards mathematics. The mean score was 5.41 and median 5. As these figures are close together, this indicates the data is normally distributed with fewer peers’ having very negative or very positive attitudes towards mathematics.

Factor analysis was conducted to assess the validity of the measure. The correlation coefficients outputted high values (Appendix C.2), indicating that the items correlate with the factor being analysed. Principal axis factoring was used. The KMO and Bartlett’s Test of Sphericity gave a value of .648 (Appendix C.2) that indicates the sample is adequate enough to conduct factor analysis. Like the measure above, I took Joliffe’s (2005) recommendation of extracting eigen values greater than 0.7 to reduce the amount of variance and to make sure the correct number of factors were measured. The factor matrix identified that all three statements are measuring one factor that can be computed into one variable ‘peer attitudes towards mathematics’.

Table 11: Factor analysis output for peer attitudes measure

	Factor 1
My friends like maths	.821
My friends think maths is important	.691
My friends do maths outside of school	.533

Table 12: Overview of pupils’, parents and peer measures of attitudes towards mathematics

Pupil	**Parent**	**Peer**
I like maths	I liked maths	My friends like maths
I do not like maths	I did not like maths	
Maths is hard	Maths was hard	
Maths is easy	Maths was easy	
I am good at maths	I was good at maths	
I do maths at home	I did maths at home	My friends do maths at home
Maths is important		My friends think maths is important
I enjoy maths when in class		
GCSE maths is relevant to everyday life	GCSE maths is relevant to everyday life	
Maths is boring	Maths was boring	My friends think maths is boring
I like my maths teacher	I liked my maths teacher	

Measuring value and relevance

Factor analysis is one of the most widely used statistical methods in the social sciences, and in particular within education and sociology (Holmes Finch, 2020). It is common because as sociologists, we are interested in understanding social characteristics that cannot be directly observed, such as academic achievement, confidence and attitudes (Massey, 2019). The purpose of factor analysis is to measure a particular social characteristic by the correlation of variables that attempt to measure that construct. There can be many things that influence a person to answer a question in a particular way such as misinterpreting a question or accidentally providing a wrong answer. It is acknowledged that measuring psychological constructs using one statement is very challenging (Massey, 2019), therefore the more questions used to measure a particular social characteristic, the higher the reliability and validity of the measure.

Holmes Finch (2020) identifies the importance of having strong theory to underpin the successful use of factor analysis, and how this theory should serve as the basis upon which we understand the variables that this method is designed to describe. Fernandes (2004, 2008 cited in Pais 2013) identified that students knew they would not use any of the mathematics they were learning in their job role, but still had the belief that maths was important as they needed it to pass their course. This distinguishes between the value and the relevance of Mathematics in terms of needing it to pass the exam, as a gateway for further study and employment or using it in everyday life and in jobs.

In terms of the relevance of Mathematics, Hernandez-Martinez and Vos (2018) define it as the connection between the topic being learnt, its usefulness and the learner. Onion (2004) identified that the majority of 14–16-year-olds thought that the Mathematics they are taught in school is only useful in Mathematics lessons and exams; they could not see how these skills would translate to be useful in everyday life.

This literature was used to develop three statements that are used to measure the value and relevance of Mathematics.

Table 13: Overview of the statements used to measure In-School Value, Out-School Value and Relevance of mathematics

Statement 1	Learning the (number/algebra/ ratio, proportion and rates of change /geometry and measure/ probability/ statistics) topic in maths will help me pass my exam	In-School Value
Statement 2	- Learning the (number/algebra/ ratio, proportion and rates of change /geometry and measure/ probability/ statistics) topic in maths will give me more career opportunities	Out-School Value
Statement 3	I will use the (number/algebra/ ratio, proportion and rates of change /geometry and measure/ probability/ statistics) topic I learn in maths in everyday life – relevance	Relevance

The correlation coefficients outputted high values (Appendix C.4), indicating that the items correlate with the factor being analysed. As this measure was being tested for the first time, principal axis factoring was used. The KMO and Bartlett's Test of Sphericity gave a value of .903 that indicates the sample is adequate enough to conduct factor analysis. I took Joliffe's (2005) recommendation of extracting eigen values greater than 0.7 to reduce the amount of variance and better ensure the correct number of factors are extracted.

The first factor correlation matrix using oblimin rotation shows values above 0.4, which indicates some items are measuring the same factor. Therefore, varimax rotation was used as this method of rotation assumes factors are not correlated (Massey, 2019). This identified 3 factors where each item measuring exam was in factor 1, career was in factor 2 and everyday life was in factor 3.

Table 14: Factor analysis output for measures of In-School Value, Out-School Value and Relevance of mathematics.

Variable	**Factor 1**	**Factor 2**	**Factor 3**
Learning the number topic in maths will help me to pass my maths exam	.517		
Learning the number topic in maths will give me more career opportunities		.545	
I will use the number topic I learn in maths in everyday life			.452
Learning the algebra topic in maths will help me to pass my maths exam	.619		
Learning the algebra topic in maths will give me more career opportunities		.633	
I will use the algebra topic I learn in maths in everyday life			.628
Learning the ratio, proportion and rates of change topic in maths will help me to pass my maths exam	.723		
Learning the ratio, proportion and rates of change topic in maths will give me more career opportunities		.663	
I will use the ratio, proportion and rates of change topic I learn in maths in everyday life			.698
Learning the geometry and measures topic in maths will help me to pass my maths exam	.697		
Learning the geometry and measures topic in maths will give me more career opportunities		.736	
I will use the geometry and measures topic I learn in maths in everyday life			.692
Learning the probability topic in maths will help me to pass my maths exam	.686		

Learning the probability topic in maths will give me more career opportunities		.709	
I will use the probability topic I learn in maths in everyday life			.685
Learning the statistics topic in maths will help me to pass my maths exam	.737		
Learning the statistics topic in maths will give me more career opportunities		.654	
I will use the statistics topic I learn in maths in everyday life			.714

This provides evidence that there are three different constructs being measured; In-School value, Out-School value and relevance (Appendix C.4). Each individual variable was recoded to create a scale variable for analysis. Each variable is on a scale of 0-6 that indicates the higher the score, the more In-School, value, Out-School value or relevance of mathematics.

Table 15: Recoding of each measurement to change to scale variable.

Original Variable		**New Variable**	
Value	Label	Value	Label
1	Yes	1	Yes
2	No	0	No

Reliability of value and relevance factors

Cronbach's alpha was conducted to check for the reliability of the measures. Each variable has a value over the threshold of 0.7, which indicates all measures are reliable. When looking at the mean, median and mode they are all slightly skewed. This is due to the statements being on a small scale as the question only had two categories: yes or no. As this is still a valid and reliable measure, for future analysis a Likert scale would be preferred to give a more even distribution of data.

Table 16: Reliability and measures of central tendency for In-School Value, Out-School Value and Relevance of mathematics

	In-School Value	Out-School Value	Relevance
Reliability	.838	.860	.825
Mean	5.24	3.73	2.11
Median	6	4	1.5
Mode	6	6	0
Minimum	0	0	0
Maximum	6	6	6

Measuring confidence

Confidence was measured by using a criterion test-based approach with statements taken from the GCSE key stage 3 curriculum of what students should know by the end of year 9. Two items were chosen from each topic where pupils were asked to rate how confident they were with the statements on a scale of 1 to 5. This means the higher the scale, the more confident pupils were. To ensure reliability of the measure, Cronbach's Alpha was used.

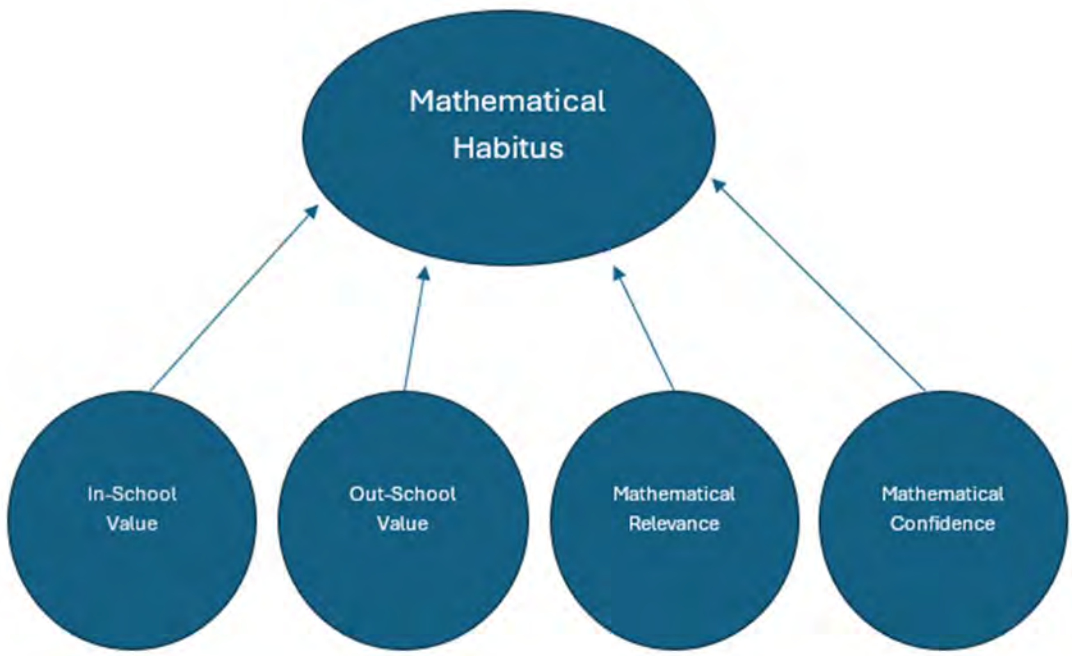
The results from the Cronbach's Alpha indicated the measure of confidence was reliable (.854) as it was above the threshold of 0.7. However, the aim should always be to ensure the highest reliability possible (Cronbach, 1951) therefore, 'Use and interpret algebraic notation 3y in place of y+y+y' and 'Understand that the probability of all outcomes sum to 1' was deleted that gave a higher score of .913.

Structural Equation Modelling: The Harris Dispositional Framework

Structural equation modelling was used to understand whether all four dependent variables, that are also latent constructs, In-School value, Out-School value, relevance and mathematical confidence, contribute to an overarching latent construct of *Mathematical Habitus*. This is important for this research as it will be used to provide evidence of the complexity of mathematical attainment and the impact of socio-cultural and demographic factors on the practice of mathematics. Previous factor analysis indicated that In-School value, Out-School value and relevance are three different factors, with Cronbach's Alpha indicating that all measures including mathematical confidence are reliable. Previous literature focuses on value, relevance and confidence being important for mathematical attainment (Hernandez-Martinez and Vos, 2018; The Sutton Trust 2024), therefore research in interested in whether these four factors contribute to a latent construct and can be used to measure *Mathematical Habitus*.

The model below evidences the Harris Dispositional Framework to show how In-School value, Out-School value, relevance and confidence lend themselves to the overarching construct of *Mathematical Habitus.*

Figure 2: Harris Dispositional Framework



Structural equation modelling must pass a series of parametric assumptions for it be carried out. The first assumption is normality of data which is shown in univariate and factor analysis that the data is normally distributed. The second assumption is the minimum fitness indices that the model indicates the minimum was achieved, and the third is the model fit. There are many different measures of model fit that are widely debated. Many researchers use chi-square value, however it is sensitive to sample size and is not accurate for sample sizes above 200 (Schumacker and Lomax, 2010). Therefore, Hair *et al* (1992) suggest using various model fit indices in combination to assess model fit, model comparison and model parsimony as one model fit criteria cannot meet all of these criteria (Schumacker and Lomax, 2010). If a majority of fit indices indicate an acceptable model, then this indicates that the theoretical model is supported by data. In this research I use four indices: Root mean square error of approximation (RMSEA), Tucker Lewis Index (TLI), Normed Fit Index (NFI) and Parsimony Fit Index (PNFI).

Table 17: Parametric assumption threshold and result for structural equation model

Fit indices	**Threshold**	**Result**
RMSEA	<.05	.049
TLI	>.90	.911
NFI	>.90	.907
PNFI	Close to 1	.782

The RMSEA has a value of 0.49, that according to Browne and Cudleck (1993) indicates a close fit. TLI and NFI refers to model comparison. The TLI value (.911) and NFI (.907) indicate a good model fit (Bentlet and Bonett,1980; Loehlin, 1987). Lastly, the PNFI refers to model parsimony .782. All parametric assumptions were met, therefore the model can be analysed.

Table 18: Structural equation model output

Factor	**Factor loading**	**Unstandardised Regression Weight**	**Significance**
In-School value	.320	.32	<.001
Out-School value	.549	.55	<.001
Relevance	.427	.43	<.001
Confidence	Reference group		

The factor loadings and R squared values indicate that they are all above the 0.3 threshold that Hair *et al* (1992) suggests for samples over 350, therefore supports the argument that *Mathematical Habitus* has four sub-constructs and is significant at p=<.001. The unstandardised regression weights indicate that an increase of 1 of ‘In-School value’ increases *Mathematical Habitus* by .32, an increase of 1 in ‘Out-School value’ increases *Mathematical Habitus* by .55 and an increase in 1 in ‘relevance’ increases *Mathematical Habitus* by .43. Therefore, not only does this provide evidence of the four factors contributing to the overarching construct of *Mathematical Habitus,* it also provides evidence how each latent construct impacts *Mathematical Habitus* differently, indicating that out-school value increases *Mathematical Habitus* more than In-School value, relevance and confidence. Therefore, these dispositions can be used as a framework as a starting point to capture *Mathematical Habitus*.

Statistical analysis

This section outlines the rationale for the selection of each statistical test employed in the analysis, explaining how each method aligns with the research objectives. It also details the recoding procedures applied to variables in preparation for statistical modelling, ensuring the data was appropriately structured for meaningful analysis.

Univariate Analysis

Descriptive statistics are important for three main areas; exploring data, cleaning and preparing data, and producing narratives (Scott Jones and Goldring, 2022). Firstly, descriptive statistics were used for categorical and interval data to identify any errors and remove them to ensure it is adequate for parametric testing. Any outliers were removed to ensure normal distribution of the data. Univariate analysis was also used to prepare data for the bivariate and multivariate analysis stage of analysis, to recode and dummy code variables to best fit the criteria for regression and multi-level modelling. Alongside preparing data for inferential testing, it is important to look at the measurements of variables to ensure they are theoretically sound. For example, ethnicity was recoded from a 16-item scale to a 5-point scale taking inspiration from the Census 2021 measurement of ethnicity. This allowed for more accurate statistical analysis, but is also accepted theoretically to ensure differences between ethnic groups are still able to be capsulated. Once data was cleaned and prepared, the sample was then explored to understand the demographic makeup of the sample, but also how respondents were answering each question in relation to their demographics and attitudes.

Bivariate Analysis

Once the individual variables were cleaned and prepared, bivariate analysis was conducted to explore key trends, statistical differences, and relationships between pairs of variables. Specifically, independent variables were tested against four dependent variables to determine whether statistically significant relationships or differences existed. An alpha threshold of .05 was set, meaning that p-values below .05 indicate the null hypothesis can be rejected, thus controlling for the risk of a Type I error and providing evidence that the findings are likely to be true for the wider population (Field, 2018).

Before performing the bivariate tests, parametric testing was carried out to ensure that all necessary assumptions were met. This step was essential to confirm the validity and reliability of the data and to ensure that the statistical tests used were appropriate. While regression and multilevel modelling are ultimately preferred given their alignment with the theoretical and epistemological foundations of this research, it was important to begin with bivariate analysis. This allowed for an initial exploration of the data and ensured a linear, step-by-step process, helping to determine whether the data were suitable for more advanced statistical modelling.

Hypothesis testing

This research adopts a frequentist approach. As a critical realist, hypothesis testing is used to produce valid and reliable findings that explore the relationships between various demographic and cultural factors. While hypothesis testing typically supports the generalisability of quantitative research findings to a wider population through the use of p-values, this is not the case here due to the sampling strategy employed. Instead, hypotheses are used to guide the data analysis process, helping to select the most appropriate methods for the data and research questions, and to make informed predictions.

Hypotheses are used to examine the relationships and differences between a series of independent and dependent variables, each representing different socio-demographic factors, forms of capital, and parental and peer attitudes. These are analysed in relation to four key constructs: In-School Value, Out-School

Value, Relevance, and Confidence in mathematics, in an effort to measure *Mathematical Habitus*.

A deductive approach is taken, using theory to generate hypotheses that reflect expected outcomes based on existing literature (Clark, 2021). In line with standard statistical practice, the null hypothesis, which assumes no relationship or difference between variables, is always tested (Field, 2018). These theoretical predictions are then statistically tested, allowing the null hypothesis to be either supported or refuted. A full list of hypotheses can be found in the appendices.

Parametric testing for bivariate analysis

Parametric testing is essential to ensure that the most appropriate statistical tests are applied to the data. Without it, there is a risk of producing inaccurate results, misinterpretations, and errors in the analysis (Field, 2018). While different types of analyses have their own assumptions, this research specifically tests for normality, linearity, homogeneity, and homoscedasticity. The choice of statistical test depends on whether these assumptions are met.

For bivariate analysis involving one scale and one categorical variable, these assumptions must be satisfied (Kantor and Kershaw, 2010). If they are, and the comparison involves two groups, a t-test is used; if there are more than two groups, an ANOVA is appropriate. If the assumptions are not met, non-parametric alternatives are used: the Mann-Whitney test for two groups, and the Kruskal-Wallis test for more than two.

When bivariate analysis involves two scale variables, four assumptions must then be met: both variables must be scale, and the data must meet the assumptions of normality, homogeneity, and linearity (Sheskin, 2007). If these are satisfied, a Pearson's r correlation can be conducted. If not, the non-parametric alternative, Spearman's rho, is used.

Multivariate Analysis

Multivariate analysis is used to explore the complexity of data collection to answer research questions 2 and 3 to identify the key predictors of *Mathematical Habitus*. It also aligns with the theoretical framework (Bourdieu 1977; 1990) to provide empirical evidence of the interconnectedness of socio-cultural factors and structures on mathematical practices.

Parametric assumptions testing for regression analysis

Depending on the type of multivariate analysis depends on the type of parametric assumptions. In this research, multi linear regression is used that has four main parametric assumptions: normality, linearity, multicollinearity and homoscedasticity. (Field, 2018). This research uses correlation values, tolerance and VIF, and eigen values to test for multicollinearity. If data passes at least two of these, we can assume we have no multicollinearity (Field, 2018). If all parametric assumptions are passed, multivariate linear regression can be used. If it fails, the variable that has failed must be identified and removed from the model and tried again. There is no parametric version of regression.

Multi-linear Regression

Multi-linear regression is a very popular and powerful tool used for exploring relationships between variables and predicting outcomes. It is very useful within educational research as it can help to identify factors that affect pupils' educational outcomes such as gender, ethnicity and socio-economic background (Morrison *et al*, 2012; Saxena and Gupta, 2022). This research uses multiple linear regression to help identify factors that affect pupils In-School value, Out-School value, Relevance and Confidence in mathematics, and *Mathematical Habitus*. Regression analysis allows for valid and reliable empirical evidence to be gathered that provides answers to the research questions. Independent variables were dummy coded prior to analysis to meet the criteria of the test.

The first step is estimating the model fit to ensure the results obtain accurate predictions by calculating the difference between the expected and observed results. Significance (alpha values less than .05) should be used in conjunction with the F statistic that indicates the effectiveness of the model in explaining the variance within the dependent variable. An F value above 7 is good. However, F values can be dependent on the distribution of the data measured by the degrees of freedom and sample size, therefore critical F values are used if the F value is below the threshold of 7 to give a more accurate value (Field, 2018). The r squared value indicates how much variance of the dependent variable is accounted for by the independent variables within the model (Field, 2018).

In the regression models, ‘pupils’ attitudes towards mathematics’ was not included due to issues with multicollinearity (see validity of the relationship between pupils attitudes towards mathematics and dispositions towards mathematics in methodology section).’Parents help with homework’ and ‘receiving extra maths tuition’ and were not included due their impact on the model fit. Removing these variables increased the adjusted r squared and model fit levels, suggesting that the other variables in the model contributed to more of the variance. Furthermore, taking inspiration from Bourdieu’s (1990) education careers and determinations model and theory of practice (1984) these variables do not fit within the framework.

Recoding Variables

This section outlines the process of recoding variables for this research to ensure enhanced statistical power and the reduction in chance of type 1 and type 2 errors as it increases the sample size for each category (Field, 2024). Dummy coding is the process of transforming ordinal variables into nominal variable for regression modelling analysis. Some variables also require reverse coding to ensure that the higher the number indicates a higher score such as the more positive the pupils’ attitudes.

Ethnicity

Table 19: Ethnicity recoding

Ethnicity			
Label	**Value**	**New value**	**New label**
White	1	1	White
White Irish	2	1	
Other white background	3	1	
Indian	4	2	Asian
Pakistani	5	2	
Bangladeshi	6	2	
Any other Asian background	7	2	
British Chinese	8	3	Chinese
Chinese	9	3	
African	10	4	Black
Caribbean	11	4	
Any other black background	12	4	
White and Asian	13	5	Mixed
White and black	14	5	
White and Chinese	15	5	
White and any other	16	5	

The above table shows the process of recoding for the variable ethnicity. Inspiration was taken from the Government's Race Disparity Unit (2023) on best practice of measuring ethnicity. The 'other' category was not included due to literature suggesting that very few people populate themselves into this category (2.5% (DfE, 2024b)) which would yield issues for statistical analysis, especially due this being a small-scale research project according to the national research.

Therefore, the opportunity for ‘other’ within each category was included, such as ‘white and other’. This seemed successful as 88.2 % of the sample answered the question. Due to the unequal sample sizes across all categories, these were recoded to make larger groups that could be used in statistical analysis, with the aim to not reduce the diversity between groups too much. The decision was made to distinguish between South Asian and Chinese due to guidance from the literature of these groups being culturally different, but also due to differences in attainment levels (DfE, 2024; The Sutton Trust, 2016; Richardson *et al*, 2020).

Recoding and dummy coding for regression

Variables using Likert Scales

Table 20: Recoding of Likert scales

Original Variable		**New Variable**		**Recoded Variable**		**Dummy Variable**	
Value	Label	Value	Label	Value	Label	Value	Label
1	Strongly Agree	1	Strongly Disagree	1	Disagree	0	Disagree
2	Agree	2	Disagree				
3	Not sure	3	Not Sure	Missing	Missing		
4	Disagree	4	Agree	2	Agree	1	Agree
5	Strongly Disagree	5	Strongly Agree				

The above table shows the process of recoding for analysis. The original variables use a Likert scale coded 1-Strongly agree through to 5- Strong disagree. For analysis to provide a scale whereby the higher the score the higher the attitude, this was reverse coded (1-Strongly disagree through to 5 – strongly agree), with the category ‘not sure’ put within missing data as this response does not add any perspective to the study. To include these variables in regression analysis, they have to be recoded into dichotomous categories, therefore strongly agree and agree were computed into one category labelled agree, and strongly disagree and disagree were computed into one category labelled disagree. This then allowed for dummy variables to be created. As this research is interested in the effects of attitudes, it was decided that agree would be the testing category for each variable.

Gender

Table 21: Recoding of gender

Original Variable		**Recoded Variable**		**Dummy Variable**	
Value	Label	Value	Label	Value	Label
1	Male	1	Male	0	Female
2	Female	2	Female	1	Male
3	Other	3	Missing	3	Missing

The above table shows the process of recoding of the variable gender for analysis. The original variable had three categories: male, female and other. Due to the other category being such a small sample size (n44), this could cause problems for statistical analysis due to the unequal distribution of data. Therefore, the decision was made to not include the 'other' category in statistical testing. When creating dummy codes for regression analysis, due to literature proving rationale that males do between than females and are more confident in mathematics, the decision was to have males as the testing variable and female as the control variable.

Ethnicity

Table 22: Ethnicity dummy coding

Original Variable Ethnicity		Dummy Variable White		Dummy Variable South Asian		Dummy Variable Chinese		Dummy Variable Black	
Value	**Label**	**Value**	**Label**	**Value**	**Label**	**Value**	**Label**	**Value**	**Label**
1	White	1	White	0	White	0	White	0	White
2	South Asian	0	South Asian	1	South Asian	0	South Asian	0	South Asian
3	Chinese	0	Chinese	0	Chinese	1	Chinese	0	Chinese
4	Black	0	Black	0	Black	0	Black	1	Black
5	Mixed	0		0	Mixed	0	Mixed	0	Mixed

The above table shows the process of recoding of the variable ethnicity for analysis. The recoded variables had five categories: White, South Asian, Chinese, Black and Mixed. When creating dummy codes for regression analysis, due to there being more than two categories, five different variables had to be made, each with the ethnic group interested in analysing being compared against all other ethnic groups as the baseline groups.

Free School Meal Eligibility

Table 23: Free School Meal eligibility dummy coding

Original Variable		**Dummy Variable**	
Value	Label	Value	Label
1	Yes	0	No
2	No	1	Yes

The above tables shows the process of dummy coding the variables free school meals and English as an additional language. As this research is interested whether having any of these impacts *Mathematical Habitus*, the decision was made to make ‘yes’ the testing category and no the baseline.

Chapter 4: Assessing the sample

This chapter explores the demographics of the research sample and explores trends in deprivation levels of schools including the proportion of free school meal eligibility, and the value and relevance of the mathematics curriculum. Frequency tables are used for categorical ordinal and nominal variables to identify the number of respondents in each category, with measures of central tendency used for scale variables to identify the distribution of the data.

Pupil demographics

Gender

Gender	N	Valid Percent
Male	990	59.1
Female	641	38.3
Other	44	2.6

Table 24: Pupils gender

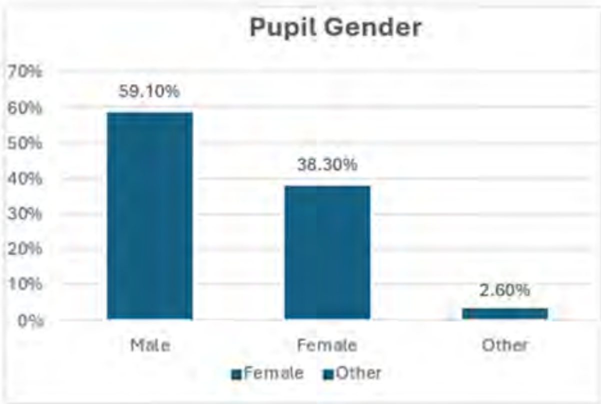


Figure 3: Bar chart of pupils' gender

Table 24 and figure 3 show that 59.1% (n990) of the sample identfied as male, 38.3% (n641) identified as female and 2.6% (n44) identified as other. This is higher than the national average of boys in year 9 at 51.25%, and lower than the national average of girls at 48.75% (GOV, 2023). It is important to highlight that two of the schools in the study were boys only schools, that has caused this higher percentage of boys in the sample than the national average that has the potential to skew the measures of central tendency for In-School Value, Out-School Value, Relevance, Confidence and *Mathematical Habitus,* but will not impact on the reliability of the results due to the appropriate sample size and use of parametric testing.

National statistics do not measure any other gender, however the decision was made to measure 'other' which 2.6% (n44) pupils identified as. Although this is a small number of pupils, it does highlight the need to measure this category.

Pupils Ethnicity

Ethnicity	N	Valid Percent
White	817	52.7
South Asian	450	29.0
Chinese	33	2.1
Black	168	10.8
Mixed	83	5.4

Table 25: Pupils ethnicity

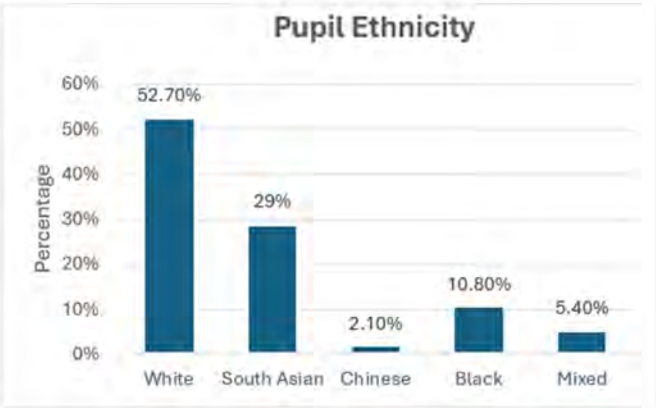


Figure 4: Bar chart of pupils’ ethnicity

Table 25 and figure 4 show that 52.7% (n817) of the sample were from a white background, 29% (n450) from a South Asian background, 2.1% (n33) from a Chinese background, 10.8% (n168) from a Black background and 5.4% (n83) mixed. This is compared to national average of those attending secondary state schools; 70.4% white, 12.1% South Asian, 0.7% Chinese, 6% African and 6.8% Mixed (GOV, 2023). This research has a higher proportion of pupils from South Asian and Chinese backgrounds than the national average, similar to gender, that has the potential to skew the measures of central tendency for In-School Value, Out-School Value, Relevance, Confidence and *Mathematical Habitus,* but will not impact on the reliability of the results due to the appropriate sample size use of parametric testing.

English as an additional language

EAL	N	Valid Percent
Yes	719	43
No	953	57

Table 26: English as an Additional language

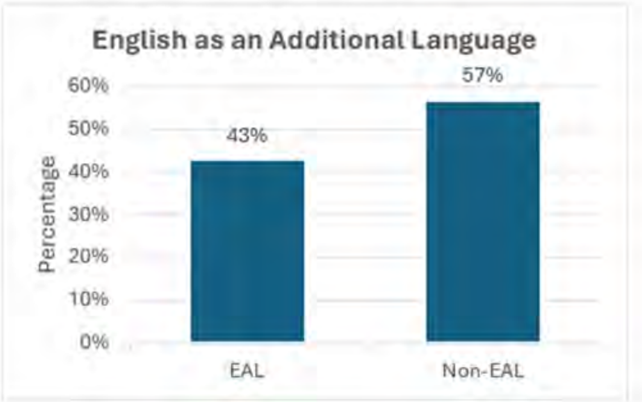


Figure 5: Bar chart of pupils that speak English as an additional language

Table 26 and figure 5 show that 43% (n719) of pupils' in the sample speak English as an additional language and 57% (n953) of pupils' do not speak English as an additional language. This is higher than the national average (18.1%) and the regional average of 14.7% (GOV, 2023). There is debate that English as an additional language should measure language proficiency (DfE, 2019; Strand *et al*, 2015) with The Sutton Trust (2016) highlighting the close link between ethnicity and speaking English as an additional language. Therefore, as this sample does have a higher percentage of pupils from ethnic minority backgrounds, we can also expect a higher proportion of pupils that speak English as an additional language. These higher levels will not impact the reliability of results as this research uses parametric testing to use the more appropriate test for the data.

Free School Meal eligibility

FSM	N	Valid Percent
Yes	522	31.3
No	1148	68.7

Table 27: Free school meal eligibility

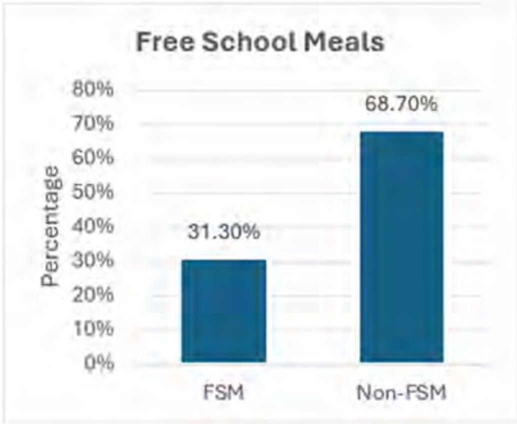


Figure 6: Bar chart for pupils' free school meal eligibility

Table 27 and figure 6 shows that 31.3% (n522) of the sample are eligible for free school meals. This is higher than the Secondary school average in England of 24.3% and the regional average of 27.2% (GOV, 2023). The one-samples *t*-test found a significant difference (p=<.001) when comparing the percentage of free school meals in this sample, compared to the national and regional average. Indicating that those in this sample experience more deprivation in relation to their eligibility of free school meals compared to the rest of Year 9 pupils in the North West and England.

Extra maths tuition

Extra maths tuition	N	Valid Percent
Yes	143	8.5
No	1539	91.5

Table 28: Extra maths tuition

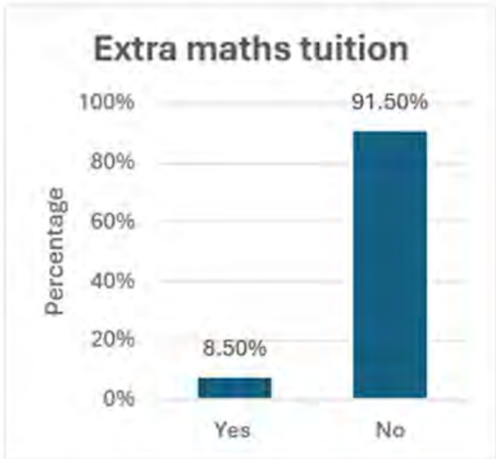


Figure 7: Bar chart for whether pupils have extra maths tuition

Table 28 and figure 7 shows that only 8.5% (n143) have extra maths tuition outside of school. Extra maths tuition is not something that is not commonly measured, however research from The Sutton Trust (2024) identify the uptake of tutoring via The National Tutoring Programme to support those from disadvantaged backgrounds to improve their attainment levels.

Parents help with maths homework

Parents help with maths homework	N	Valid Percent
Yes	430	25.9
No	1233	74.1

Table 29: Parents help with maths homework

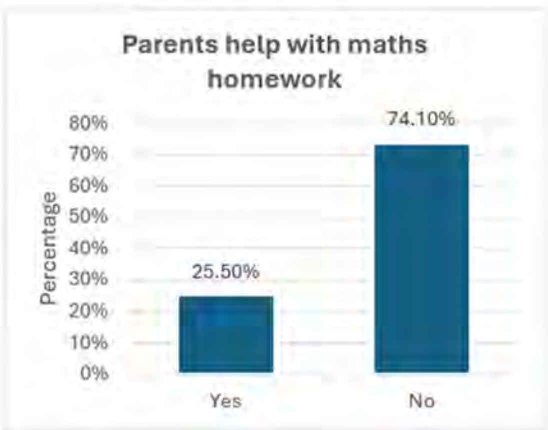


Figure 8: Bar chart for whether parents help pupils with their maths homework

Table 29 and figure 8 shows that 25.9% (n430) of parents help their child with their maths homework. This is not something that is commonly measured, however National Numeracy (2024) highlight how 23% of adults are anxious when helping their child with the homework, with 20% admitting it has caused arguments with their child. This indicates a negative impact on the child where this anxiety and negativity can be handed down from parent to child (National Numeracy, 2024).

Teacher gender

Teacher gender	N	Valid Percent
Male	643	39.6%
Female	981	60.4%

Table 30: Teacher gender

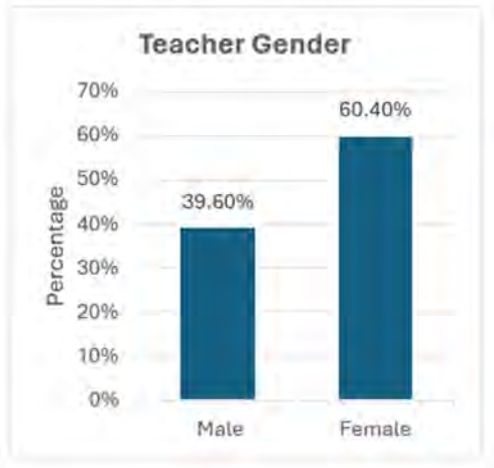


Figure 9: Bar chart for teachers’ gender

Table 30 and figure 9 shows that 39.6% (n643) of pupils have a male maths teacher and 60.4% (n981) of pupils have a female maths teacher. This is comparable to the national average of 64.64% females and 35.36% male teachers, and regional average of 65.52% female maths teachers and 34.48% male maths teachers (Department for Education, 2023).

Pupils’ attitudes towards mathematics

N	1605
Mean	22.44
Median	21.00
Mode	30.00
Minimum	11.00
Maximum	44.00
Range	33.00
Std deviation	7.39

Table 31: Measures of Central Tendency for pupils’ attitudes towards mathematics

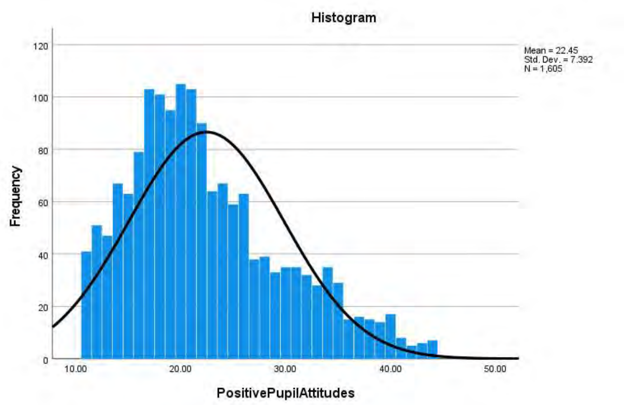


Figure 10: Histogram for pupils’ attitudes towards mathematics

Table 31 and figure 10 show that on a scale of 11-44, the minimum value was 11 and the maximum value was 44. The mean value is 22.44, with 30 being the most common score. The standard deviation of 7.097 indicates that data is evenly spread. The histogram shows a skew in the distribution of data towards the left which indicates pupils' have more negative attitudes towards mathematics.

Parent demographics

Parents gender

Parent gender	N	Valid Percent
Male	105	27.9
Female	271	72.1

Table 32: Parents gender

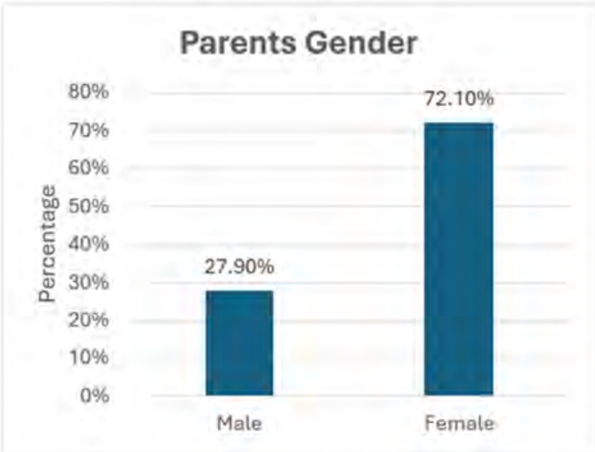


Figure 11: Bar chart for parents' gender

Table 32 and figure 11 show that 27.9% (n105) of parents that responded to the questionnaire were male, compared to 72.1% (n271) that were female. Parent surveys were conducted during parents and information evenings. Manpanje (2024) identifies that a higher proportion of mothers and involved in their child's education than their fathers, which this research reflects that narrative.

Parents ethnicity

Parent Ethnicity	N	Valid Percent
White	195	55.6
South Asian	126	35.9
Black	30	8.5

Table 33: Parents ethnicity

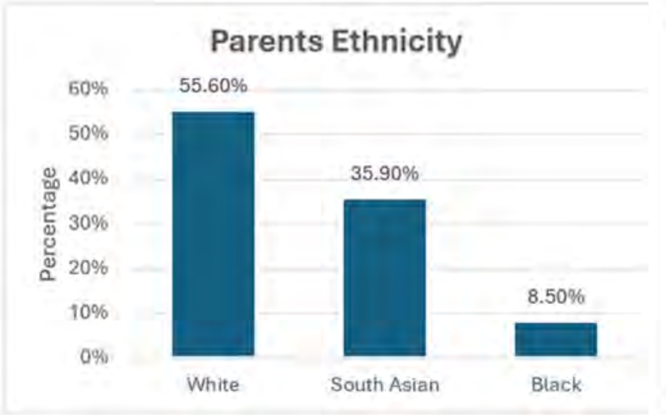


Figure 12: Bar chart for parents' ethnicity

Table 33 and figure 12 show that 55.5% (n195) of parents were from a white ethnic background, 35.9%(n126) were from a South Asian background and 8.5% (n30) were from a black background. This reflects the ethnicity of the pupils in the sample.

English as an additional language

EAL	N	Valid Percent
Yes	175	47.0
No	197	53.0

Table 34: English as an additional language

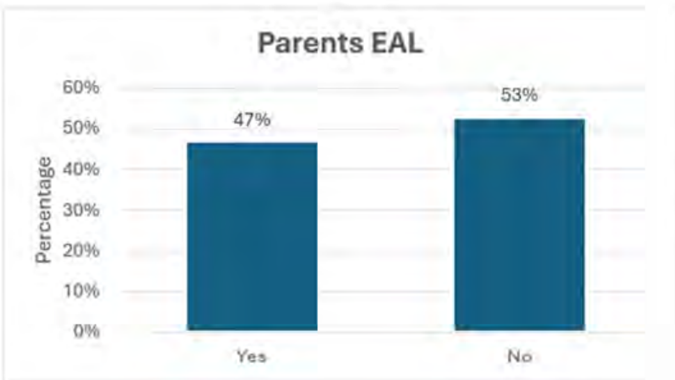


Figure 13: Bar chart for parents that speak English as an additional language

Table 34 and Figure 13 show that 47% (n175) of parents speak English as an additional language and 53% (197) do not speak English as an additional language. This is in proportion of the EAL levels of pupils but, is slightly higher for those that speak English as an additional language. The Bell Foundation (2025) suggests for schools to offer translation of important documents to allow for parents to be as involved as possible in their child's education, as many feel anxious when communication with schools due to their own lack of education (Rodriguez-Brown, 2009 cited in The Bell Foundation (2020).

Parents attitudes

N	351
Mean	14.22
Median	14.00
Mode	13.00
Minimum	6.00
Maximum	24.00
Range	18.00
Std deviation	4.644

Table 35: Measure of central tendency for positive parent attitudes

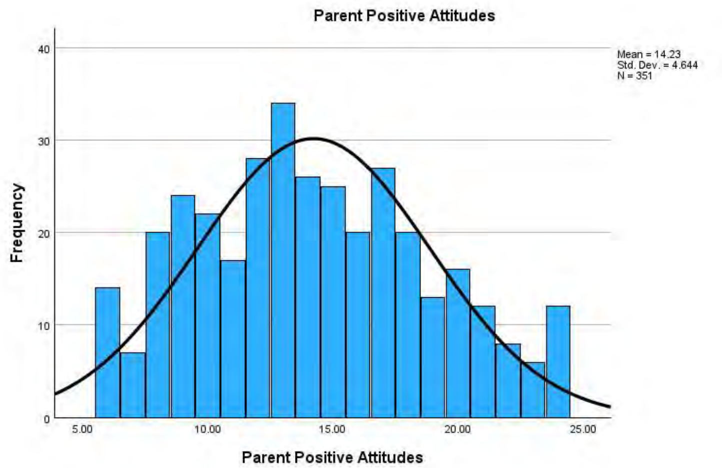


Figure 14: Histogram for positive parent attitudes

Table 35 and figure 14 show that on a scale of 4-24, the minimum value was 6 and the maximum value was 24. The histogram shows an approximately normal distribution of data, with a mean value of 14.44, and 13 being the most common answer. The standard deviation of 4.644 indicates that data is evenly spread. This suggests that parents' attitudes towards mathematics are slightly skewed to be more negative, with a lower proportion of parents having very positive attitudes towards mathematics towards the top end of the scale.

Peer Attitudes

N	1320
Mean	5.41
Median	5.00
Mode	3.00
Minimum	3.00
Maximum	12.00
Range	9.00
Std deviation	2.192

Table 36: Measures of central tendency for peer attitudes towards maths

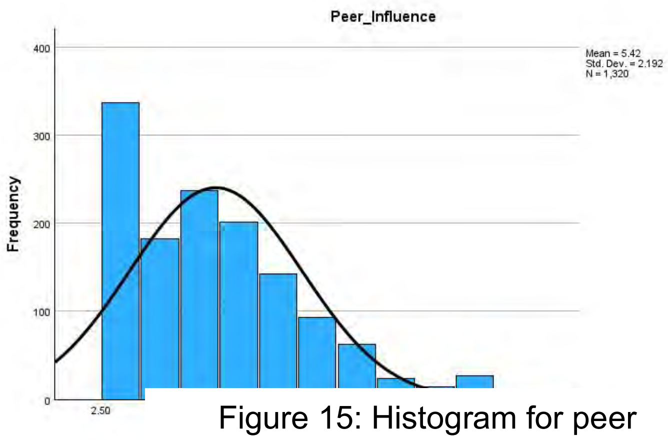


Figure 15: Histogram for peer attitudes

Table 36 and figure 15 show that peer attitudes are slightly skewed to the left indicating that more pupils believe their peers have negative attitudes towards maths. This is indicated by a lower standard deviate of 2.192. On a scale of 3-12, the average score is 5.41, with the most common answer being 3. This suggests that majority of peers have negative attitudes towards mathematics, with very few having positive attitudes towards mathematics.

Deprivation of schools

Free school meal eligibility is used as a key indicator of deprivation, with much research using this indicator to explain the attainment gap between those eligible and not eligible for free school meals (The Sutton Trust, 2023; DfE, 2018). This measure is explored in regards to free school meal eligibility between school and maths set.

Free School meal eligibility by school

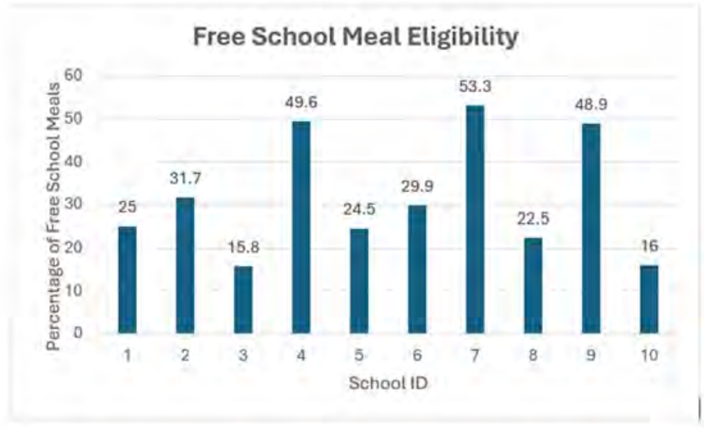


Figure 16: Percentage of free school meal eligibility according to school

Free school meal eligibility is used nationwide to compare deprivation in schools. School 7 had the highest proportion of Year 9 pupils eligible for free school meals at 53.3%, compared to school 3 with the lowest at 15.8%. On average, 31.3% of Year 9 pupils in this sample were eligible for free school meals compared to the national average of 24.3%, and the regional average of 27.2% of pupils in secondary schools that are eligible for free school meals in 2023 (GOV, 2023).

Free school meal eligibility by maths set

Set	Frequency	Percentage of pupils on FSM
1	72	18.9%
2	82	24.3%
3	91	31.5%
4	62	35.5%
5	62	44.4%
6	40	42.1%
7	37	51.4%
8	22	44%
9	19	45.5%
10	6	54.5%

Table 37: Percentage of pupils eligible for free school meals according to their maths set

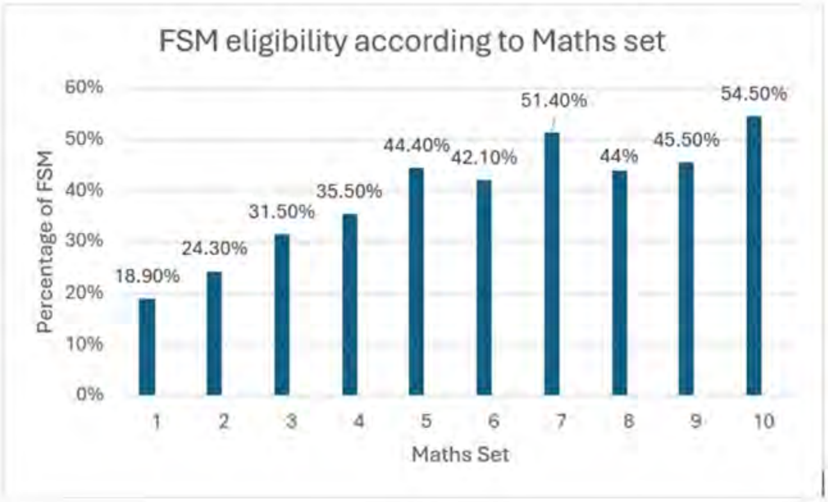


Figure 17: Free school meal percentage according to maths set

Table 37 and figure 17 show the percentage of pupils eligible for free school meals according to their maths set. Pupils are put in sets due to their ability, with set 1 being 'top set' having those pupils that are more likely to achieve the highest grades. Figure 26 shows that as ability sets decrease, the percentage of pupils eligible for free school meals increases with the exemption of sets 8 and 9 due to schools having different numbers of sets depending on the size of their cohort. In set 1, 18.90% of pupils are eligible for free school meals compared to 54.50% of pupils in set 10.

In-School value of mathematics

N	1695
Mean	5.24
Median	6.00
Mode	6.00
Minimum	0.00
Maximum	6.00
Range	6.00
Std deviation	1.475

Table 38: Measure of central tendency for In-School value of mathematics

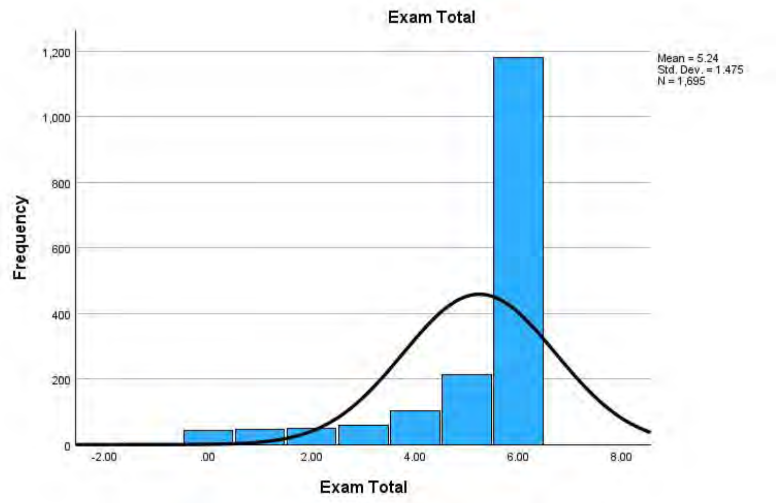


Figure 18: Histogram for In-School value of mathematics

In-School value is measured on a scale of 0-6. A higher score indicates more In-School value of mathematics. The average score across all schools was 5.24, with 6 being the most common answer, indicating that most pupils see a high level of In-School value of mathematics. Data is skewed to the right that indicates that most of the sample see the In-school value of mathematics. This is also indicated by a low standard deviation of 1.475 that shows that most data is clustered around the mean.

In-School value by school

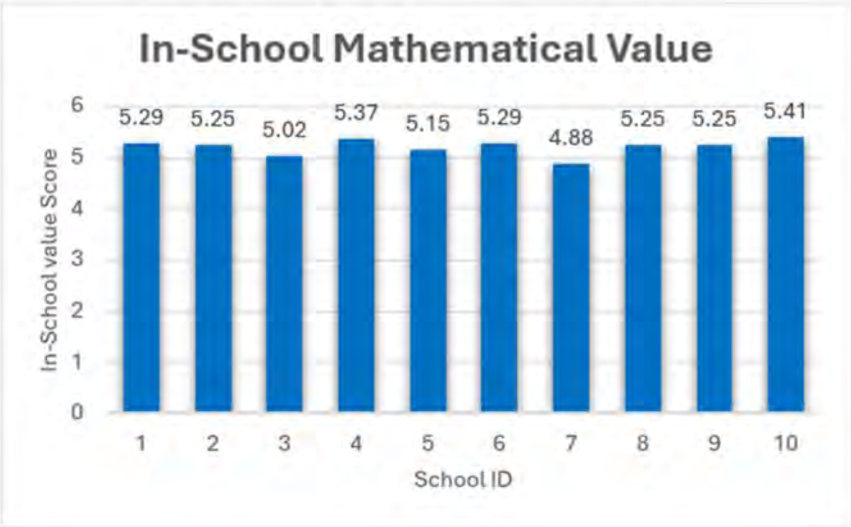


Figure 19: In-School mathematics value by school

Figure 19 shows the average In-School Value mathematics score between the different schools that participated in the study. School 10 had the highest In-School value score of 5.41, with school 7 having the lowest score of 4.88. Across all schools, school 1, 2, 4, 6, 8, 9 and 10 all had scores above average for all schools in the sample (5.24).

Out-School value

N	1692
Mean	3.73
Median	4.00
Mode	6.00
Minimum	0.00
Maximum	6.00
Range	6.00
Std deviation	2.186

Table 39: Measures of central tendency for Out-School value of mathematics

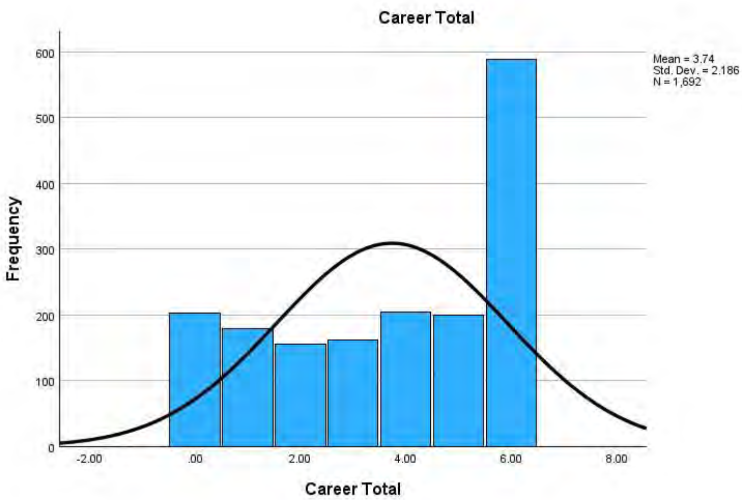


Figure 20: Histogram for Out-School value of mathematics

Out-School value is measured on a scale of 0-6. A higher score indicates more Out-School value of mathematics. The average score across all schools was 3.73, with 6 being the most common answer, that is indicated as data is skewed to the right, indicating that most pupils do see a high level of Out-School value of mathematics, however is lower compared to In-School value of mathematics. The standard deviation is 2.186 that indicates that most data is clustered around the mean.

Out-School average by school

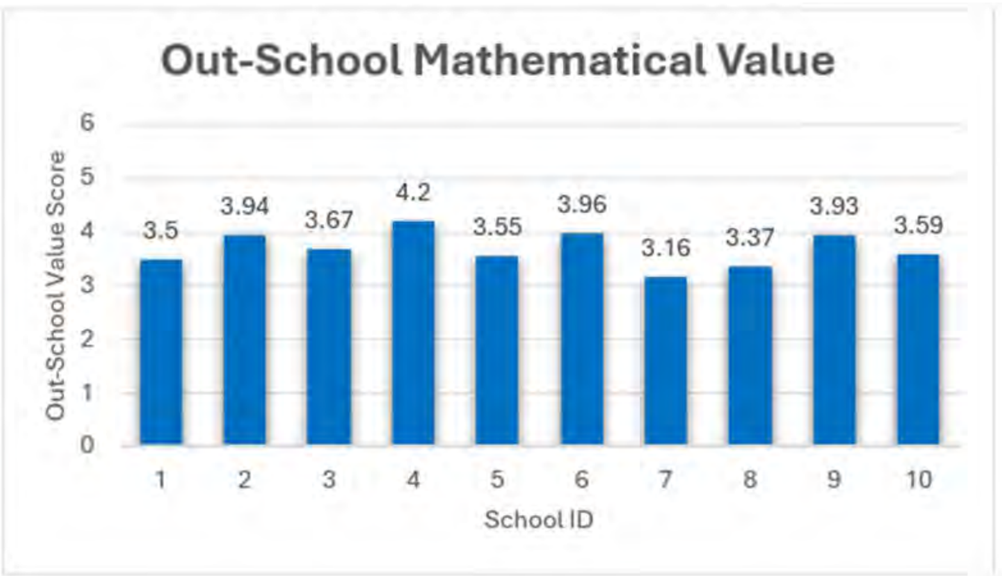


Figure 21: Out-School mathematics value by school

Figure 30 shows the average Out-School value of maths score between schools that participated in the study. School 4 had the highest score of 4.21, with school 7 having the lowest score of 3.16. School 2, 4, 6 and 9 all have Out-School value scores above average for all schools in the sample (3.74).

Relevance

N	1692
Mean	2.11
Median	1.50
Mode	0.00
Minimum	0.00
Maximum	6.00
Range	6.00
Std deviation	2.033

Table 40: Measures of central tendency for the relevance of mathematics

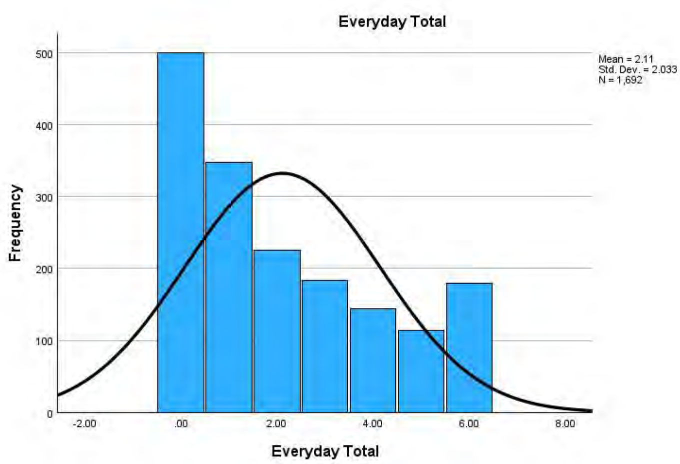


Figure 22: Histogram for the relevance of mathematics

Relevance of mathematics is measured on a scale of 0-6. A higher score indicates more relevance of mathematics. The average score across all schools is 2.11, with 0 being the most common answer, that shows with data being slightly skewed to the left which indicates that most pupils do not see the relevance of mathematics. The standard deviation is 2.033 that indicates most data is clustered around the mean.

Relevance by school

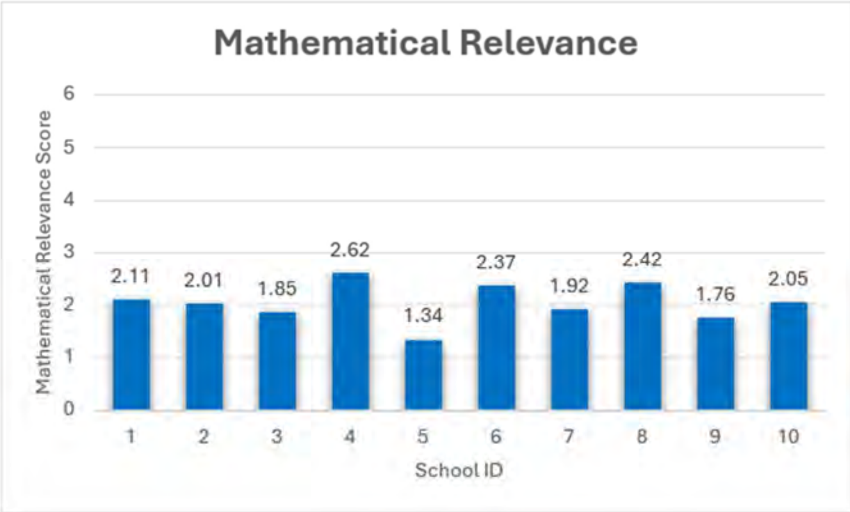


Figure 23: Mathematical relevance by school

Figure 23 shows the average relevance of maths score between schools that participated in the study. School 4 had the highest score of 2.62, with school 5 having the lowest score of 1.34. School 2, 6 and 8 have relevance scores above average for all schools in the sample (2.11). This indicates that overall pupils see less relevance in mathematics than its value.

Confidence

N	1639
Mean	40.92
Median	42.00
Mode	51.00
Minimum	12.00
Maximum	60.00
Range	48.00
Std deviation	11.131

Table 41: Measure of central tendency for pupils' mathematics confidence

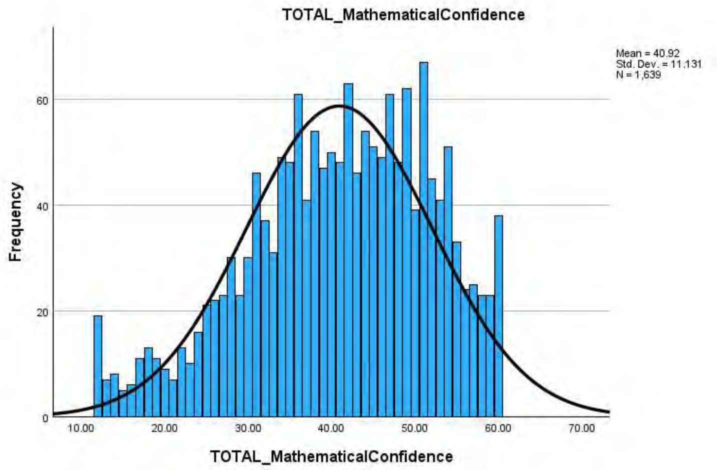


Figure 24: Histogram for mathematical confidence

Mathematical confidence is measured on a scale of 12-60. A higher score indicates more confidence of mathematics. The average score across all schools is 40.92, with 51 being the most common answer. The bell curve shows an approximately normal distribution of data, with slightly more pupil's having higher confidence levels than the mean. The standard deviation of 11.131 indicates an approximate even spread of data.

Confidence by school

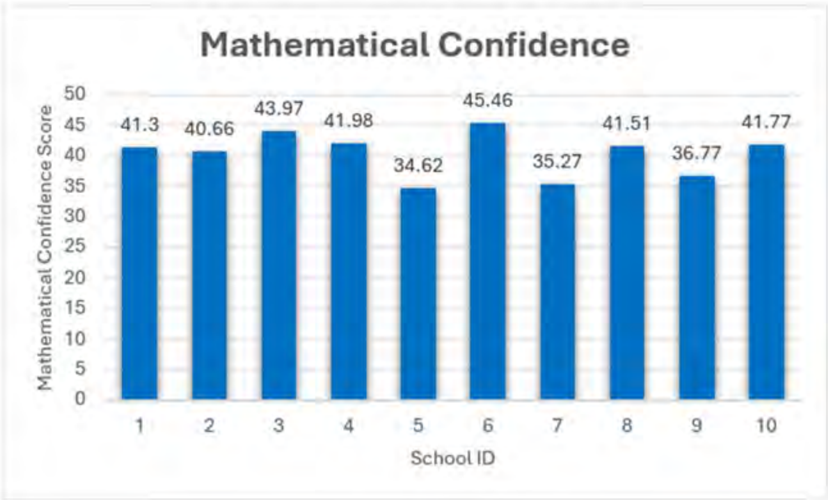


Figure 25: Mathematical confidence by school

Figure 34 shows the average mathematical confidence score between schools that participated in the study. School 6 had the highest score of 45.46, with school 5 having the lowest score of 34.62. School 1, 3, 4, 5, 8 and 10 had mathematical confidence scores above average for all schools in the sample (40.92).

Value and Relevance of the mathematics curriculum

There is ongoing debate about the national mathematics curriculum, specifically, whether it meets the needs, interests, and future aspirations of pupils. Critics question the extent to which the curriculum reflects real-world applications, particularly for students from diverse social and cultural backgrounds. This section explores pupils' perceptions of the value and relevance of the mathematics curriculum, providing insight into how they experience and interpret its purpose within and beyond the classroom. Understanding these perceptions is essential for evaluating how curriculum design may influence motivation, participation, and mathematical practices.

Number

Table 42: In-School Value, Out-School Value and Relevance of the number topic according to the sample.

In-School value	Out-School value	Relevance
90% (n1511)	72.4% (n1204)	53.9% (n888)

Algebra

Table 43: In-School Value, Out-School Value and Relevance of the algebra topic according to the sample.

In-School value	Out-School value	Relevance
89.5% (n1501)	57% (n949)	21.9% (n364)

Ratio, proportion and rates of change

Table 44: In-School Value, Out-School Value and Relevance of the ration, proportion and rates of change topic according to the sample.

In-School value	Out-School value	Relevance
90% (n1498)	63.7% (n1051)	38.7% (n639)

Geometry and measures

Table 45: In-School Value, Out-School Value and Relevance of the geometry and measure topic according to the sample.

In-School value	Out-School value	Relevance
86.3% (n1431)	60.2% (n990)	29.8% (n490)

Probability

Table 46: In-School Value, Out-School Value and Relevance of the probability topic according to the sample.

In-School value	Out-School value	Relevance
88.7% (n1461)	58.6% (n959)	32.9% (n537)

Statistics

Table 47: In-School Value, Out-School Value and Relevance of the statistics topic according to the sample.

In-School value	Out-School value	Relevance
89.9% (n1482)	71.3% (n1168)	40.3% (n654)

Overall, pupils view mathematics to hold more In-School value, that the maths they learn will help them to pass their GCSE exam, than relevance, that they will use the maths they learn in everyday life. This supports Hernandez-Martinez and Vos, (2018) and Onion (2004) that many pupils do not understand mathematics to be relevant to their current or future lives outside of school, and what they are taught is only for mathematics lessons and exams.

Out of the six topics of the mathematics curriculum, the number topic has the highest percentage of pupils 53.9% (n888) that believe it to be relevant to their everyday lives, with algebra 21.9% (n364) having the lowest levels of relevancy to their everyday lives. Research by Lave and Wenger (1998) and Nunes *et al* (1993) suggests that everyday mathematics refers to the content taught within the number topic of the curriculum but only makes up 15-25% of a GCSE exam paper, therefore proficiency in everyday mathematics does not translate to good mathematical attainment. Furthermore, Gravemeijer *et al* (2017) argues that the role of mathematics in our society is changing as mathematics is increasingly done by machines, therefore this suggests the need to move away from the more abstract, less relevant topics such as algebra and the need to focus on everyday mathematics as this is the mathematics that will benefit pupils in their everyday lives. This also sparks a debate surrounding GCSE mathematics and Functional Skills mathematics. Those that do not achieve a grade 4 or above at GCSE mathematics can work towards Level 2 Functional Skills Mathematics, which is the equivalent level to a GCSE but focuses more on ‘everyday maths’ and the application of mathematics and does not include algebra as a topic (DfE, 2024d). This suggests the irrelevancy of algebra and the potential for it to be a barrier for mathematical success, with support for a reform of the mathematics curriculum to better reflect the needs of today’s society.

Chapter 5: Testing the model: The Harris Dispositional Framework

Introduction

This chapter applies the Harris Dispositional Framework to quantitatively measure *Mathematical Habitus*, drawing inspiration from Bourdieu's (1977) theory of practice and his formula: '(*habitus* x capital) + field = practice'. While the previous chapter outlined the framework's structure, and the validity and reliability of the measure, this chapter extends that discussion by using the Harris Dispositional Framework as an analytical tool. The framework focuses on four key dispositions: In-School value, Out-School value, relevance, and confidence, as components of *habitus* that shape mathematical practice.

Given Bourdieu's assertion that *habitus* and capital must be understood in conjunction, this model enables an analysis of how socio-demographic characteristics and various forms of capital influence students' mathematical dispositions. Accordingly, factors such as gender, ethnicity, eligibility for free school meals, English as an additional language (EAL), as well as parental and peer attitudes toward mathematics, are included to reflect dimensions of social and cultural capital.

Bivariate analysis is first employed to explore how these individual factors relate to each of the four dispositions. This is followed by multivariate regression analysis to examine how these variables interact simultaneously to identify key predictors of a stronger *Mathematical Habitus.*

Informed by Bourdieu's (1990) model Educational Career and its System of Determinations, multi-level modelling is introduced to assess the effects of school and classroom level factors, offering a more comprehensive understanding of how institutional context contributes to *Mathematical Habitus*. The analysis acknowledges how demographics, capital, and dispositions interact within the educational field, shaped by the influence of peers, parents, and institutional structures. Overall, this chapter presents empirical evidence supporting the use of the Harris Dispositional Framework as a valid tool for measuring *Mathematical*

Habitus and identifying the factors that shape its strength. A discussion of the findings from the bivariate analysis is also provided.

The Harris Dispositional Framework

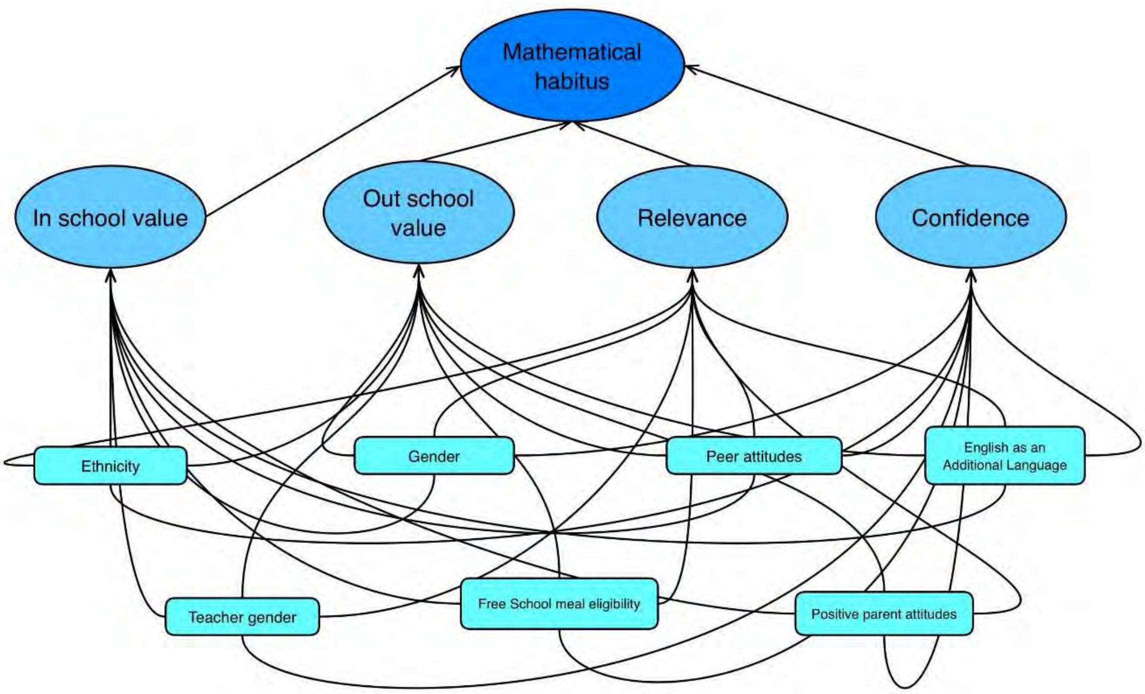


Figure 26: Using the Harris Dispositional Framework to measure *Mathematical Habitus*

Figure 26 shows the Harris Dispositional Framework consisting of four dependent variables: In-School value, Out-School value, Relevance and Confidence that lend themselves to an overarching construct of *Mathematical Habitus*. To capture *Mathematical Habitus* as a whole, this diagram demonstrates the demographic, social and cultural factors that impact *Mathematical Habitus.*

In-school Value

In-School value is one of four latent constructs that measures *Mathematical Habitus.* It refers to the pupil's belief that the maths they learn at school is useful to pass their GCSE exam. Table 48 provides an overview of the bivariate analysis carried out between pupils' demographic factors and attitudes towards mathematics to understand how these characteristics have an impact on pupils' In-School value of Mathematics. Table 49 provides an overview of parent's demographics and attitudes on In-School value and table 50 provides an overview of the impact of peer attitudes on In-School value. In-School value is measured on a scale of 1-6 with a higher score indicating a stronger disposition towards the In-School value of Mathematics to help them pass their GCSE maths exam.

Table 48 - Pupil demographics on pupils In-School value of mathematics

Impact of pupil demographics on pupils In-School value of mathematics				
(A) = ANOVA (KW)= KRUSKAL WALLIS (T)= T-TEST (MW) = MANN WHITNEY (SR) = SPEARMANS RHO				
IV	**N**	**Mean (Mean Rank)**	**df**	**Sig.**
Gender (T)			1	.725
Male	989	5.24		
Female	639	5.27		
Ethnicity (KW)			4	.082
White	817	771.39		
South Asian	450	795.77		
Chinese	33	878.92		
Black	168	744.06		
Mixed	83	709.74		
English as an Additional Language (MW)			N/A	<.001
Yes	719	792.29		
No	950	867.32		
Free School Meals (MW)			N/A	<.001
Yes	521	782.56		
No	1146	857.38		

Maths tuition (MW)			N/A	.301
Yes	143	872.54		
No	1536	836.97		
Parents help homework (T)			1	.988
Yes	429	5.24		
No	1231	5.23		
Teacher gender (MW)			N/A	.174
Male	640	795.18		
Female	981	821.32		

Interpretation of tables

Demographic factors

Gender

A *t*-Test did not identify a significant difference (p=.725) when comparing pupils' gender and the In-School value of mathematics. This provides evidence to suggest that pupils gender does not affect pupils disposition towards the In-School value of mathematics. Therefore we fail to reject the null hypothesis.

Ethnicity

A Kruskal Wallis test did not identify a significant difference (p=.082) when comparing pupils' ethnicity and In-School value of mathematics. This provides evidence to suggest that pupils ethnicity does not affect pupils disposition towards the In-School value of mathematics. Therefore we fail to reject the null hypothesis.

English as an additional Language

A Mann Whitney test identified a significant difference (p=<.001) when comparing whether pupils speak English as an additional language and the In-school value of mathematics. When comparing mean ranks, this provides evidence to suggest that those who speak English as an additional language have a stronger disposition towards the In-School value of mathematics (792.29) compared to those who do not speak English as an additional language (867.32). The null hypothesis is rejected.

Free school meal eligibility

A Mann Whitney test identified a significant difference (p=<.001) when comparing pupils free school meal eligibility and the In-School value of mathematics. When comparing mean ranks, this provides evidence to suggest that those who are eligible for free school meals have a weaker disposition towards the In-School value of mathematics (782.56) than those who are not eligible for free school meals (857.38). The null hypothesis is rejected.

Extra maths tuition

A Mann Whitney test did not identify a significant difference (p=.301) when comparing whether pupils have extra maths tuition and the In-School value of mathematics. This provides evidence to suggest that having extra maths tuition does not affect pupils In-School value of mathematics. Therefore we fail to reject the null hypothesis.

Parents help with homework

A *t*-Test did not identify a significant difference (p=.988) when comparing pupils who parents help them with their maths homework and the In-School value of mathematics. This provides evidence to suggest that pupils' who parents help them with their homework does not affect pupils' disposition towards the In-School value of mathematics Therefore we fail to reject the null hypothesis.

Teachers gender

A Mann Whitney test did not identify a significant difference (p=.174) when comparing pupils maths teachers' gender and the In-School value of mathematics. This provides evidence to suggest that the gender of the maths teacher does not affect pupils' disposition towards the In-School value of mathematics. Therefore we fail to reject the null hypothesis.

Parent demographics on pupils In-School value of mathematics

The influence of parents' demographics and attitudes on pupils' disposition towards the In-School value of mathematics is outlined below through the use of bivariate analysis. Table 49 provides an overview of the bivariate analysis carried out between parent demographic factors and attitudes towards mathematics on pupils' In-School value of Mathematics.

Table 49 – Impact of parent demographics on pupils In-School value of mathematics

Impact of parent demographics on pupils In-School value of mathematics				
(A) = ANOVA (KW)= KRUSKAL WALLIS (T)= T-TEST (MW) = MANN WHITNEY (SR) = SPEARMANS RHO				
IV	**N**	**Mean (Mean Rank)/ Correlation coefficient**	**df**	**Sig.**
Gender (T)			1	.518
Male	87	5.36		
Female	229	5.46		
Ethnicity (KW)			2	.139
White	195	143.07		
South Asian	126	159.11		
Black	30	153.87		
English as an Additional Language (T)			1	.363
Yes	145	5.51		
No	169	5.38		

Positive Parents Attitudes (S)		.061		.300

Interpretation of tables

Parent demographics

A series of *t*-Test for parents' gender and speaking English as an additional language on pupils' disposition towards the In-School value of mathematics did not identify any significant differences (p=.518, p=.363). This provides evidence to suggest that parents gender and whether the parent speaks English as an additional language does not affect the pupils' disposition towards the In-School value of mathematics. Therefore, we fail to reject the null hypotheses.

A Kruskal Wallis did not identify a significant difference (p=.139) when comparing parents' ethnicity and pupils' disposition towards the In-School value of mathematics. This provides evidence to suggest that parents ethnicity does not affect the pupils In-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Parent attitudes

A spearman's rho test did not identify a significant relationship between parents' positive attitudes and pupils' disposition towards the In-School value of mathematics (p=.300). This provides evidence to suggest that parents positive attitudes towards mathematics does not affect pupils In-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Peer Attitudes

Peer influence, measured by pupils' perception of their peer attitudes towards mathematics is outlined below. Table 50 provides an overview of the bivariate analysis carried out between peer attitudes on pupils' disposition towards the In-School value of Mathematics.

Table 50 – Peer attitudes towards mathematics

	Correlation coefficient	Sig
Peer Attitudes (SR)	.116	<.001
(SR) = SPEARMANS RHO		

A Spearman's rho test identified a significant relationship between peer attitudes towards mathematics and pupils' disposition towards the In-School value of mathematics ($p=<.001$). The correlation coefficient indicates a weak positive relationship (.116) that provides evidence to suggest that the more positive attitudes peers have towards mathematics, the stronger pupils' disposition towards the In-School value of mathematics. The null hypothesis is rejected.

Bivariate Summary

In summary, evidence suggests that pupils' disposition towards the In-School value of mathematics is dependent on the following factors:

- Free school meal eligibility - Those eligible for free school meals have a weaker disposition towards the In-School value of mathematics compared to those not eligible for free school meals.
- Speaking English as an additional language - Those who speak English as an additional language have a weaker disposition towards the In-School value of mathematics compared to those who do not speak English as an additional language.
- Peer attitudes - Those who have peers that have positive attitudes towards mathematics have a stronger disposition towards the In-School value of mathematics than those who have peers that have negative attitudes towards mathematics.

Out-school value

Out-School value is the next latent variable that measures *Mathematical Habitus*. Out-School value refers to the use of a GCSE mathematics qualification to help open more career opportunities for the pupils. Table 51 provides an overview of the bivariate analysis carried out between pupils' demographic and socio-cultural factors on pupils Out-School value of Mathematics, whereas table 52 provides an overview of parents' demographics and attitudes on Out-School value and table 53 provides an overview of the impact of peer attitudes on In-School value. Out-School value is measured on a scale of 1-6 with the higher the score, the stronger the pupils' disposition towards the Out-School value of Mathematics.

Table 51 - Pupil demographics on pupils Out-School value of mathematics

Impact of pupil demographics on pupils Out-School value of mathematics				
(A) = ANOVA (KW)= Kruskal Wallis (T)= t-Test (MW) = Mann Whitney (SR) = Spearmans rho				
IV	**N**	**Mean (Mean Rank)**	**df**	**Sig.**
Gender (T)			1	.002
Male	988	3.87		
Female	638	3.53		
Ethnicity (KW)			4	.039
White	817	754.61		
South Asian	450	779.31		
Chinese	33	937.80		
Black	168	832.01		
Mixed	83	733.87		
English as an Additional Language (T)			1	.957
Yes	717	3.73		
No	949	3.74		
Free School Meals (T)			1	.106
Yes	520	3.60		
No	1144	3.79		

Maths tuition (T)			1	.040
Yes	142	4.09		
No	1534	3.70		
Parents help homework (T)			1	.341
Yes	428	3.81		
No	1229	3.70		
Teacher gender (T)			1	.489
Male	640	3.77		
Female	979	3.69		

Interpretation of tables

Gender

A *t*-Test identified a significant difference (p=.002) when comparing pupils' gender and the Out-School value of mathematics. When comparing means, this provides evidence to suggest that males have a stronger disposition towards the Out-School value of mathematics (3.87) compared to females (5.53). The null hypothesis is rejected.

Ethnicity

A Kruskal Wallis test identified a significant difference (p=.039) when comparing pupil's ethnicity and the Out-School value of mathematics. Pairwise analysis found the biggest and most significant difference (p=.018) between those from white (754.61) and Chinese (937.80) backgrounds. This provides evidence to suggest that those from a white ethnic group have a weaker disposition towards the Out-School value of mathematics than those from a Chinese ethnic group. The null hypothesis is rejected.

English as an additional language

A *t*-Test did not identify a significant difference (p=.957) when comparing whether pupils speak English as an additional language and the Out-School value of mathematics. This provides evidence to suggest that speaking English as an additional language does not affect pupils Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Free School Meal eligibility

A *t*-Test did not identify a significant difference (p=.106) when comparing pupils free school meal eligibility and the Out-School value of mathematics. This provides evidence to suggest that free school meal eligibility does not affect pupils disposition towards the Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Extra maths tuition

A *t*-Test identified a significant difference (p=.040) when comparing whether pupils have extra maths tuition and the Out-School value of mathematics. This provides evidence to suggest that those who have extra maths tuition outside of school (4.09) see more Out-School value of mathematics than those that do not (3.70). The null hypothesis is rejected.

Parents help with homework

A *t*-Test did not identify a significant difference (p=.341) when comparing pupils who parents help them with their maths homework and the Out-School value of mathematics. This provides evidence to suggest that parents help with pupils' homework does not affect pupils' disposition towards the Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Teacher gender

A Mann Whitney test did not identify a significant difference (p=.489) when comparing pupils maths teachers' gender and the Out -School value of mathematics. This provides evidence to suggest that maths teachers gender does not affect pupils disposition towards the Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Parent demographics on pupils out-school value of mathematics

Parents demographics and attitudes on pupils Out-School value of mathematics is discussed below. Table 52 provides an overview of the bivariate analysis carried out between parents' demographic factors and attitudes towards mathematics on pupils Out-School value of Mathematics.

Table 52 – Impact of parent demographics on pupils Out-School value of mathematics

Impact of parent demographics on pupils Out-School value of mathematics				
(A) = ANOVA (KW)= Kruskal Wallis (T)= -Ttest (MW) = Mann Whitney (SR) = Spearmans rho				
IV	**N**	**Mean (Mean Rank)**	**df**	**Sig.**
Gender (T)			1	.616
Male	87	3.74		
Female	228	3.88		
Ethnicity (KW)			2	.268
White	195	144.67		
South Asian	126	150.06		
Black	30	173.00		
English as an Additional Language (T)			1	.511
Yes	145	3.93		
No	168	3.77		
Positive Parent		.167		.100

Attitudes (SR)				

Interpretation of tables

Gender

A *t*-Test did not identify a significant difference (p=.616) when comparing parents' gender and the pupils Out-School value of mathematics. This provides evidence to suggest that parents gender does not affect pupils' disposition towards the Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Ethnicity

A Kruskal Wallis did not identify a significant difference (p=.268) when comparing parents' ethnicity and pupils' Out-School value of mathematics. This provides evidence to suggest that ethnicity does not affect pupils' disposition towards the Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

English as an Additional Language

A *t*-Test did not identify a significant difference (p=.511) when comparing whether parents speak English as an additional language and pupils Out-School value of mathematics. This provides evidence to suggest that having parents that speak English as an additional language does not affect pupils' disposition towards the Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Positive parent attitudes

A Spearman's rho test did not identify a significant relationship between parents' positive attitudes and pupils Out-School value of mathematics (p=.100). This provides evidence to suggest that positive parent attitudes do not affect pupils' disposition towards the Out-School value of mathematics. Therefore, we fail to reject the null hypothesis.

Peer Attitudes

The influence of peer attitudes on pupils Out-School value of mathematics is discussed below. Table 53 provides an overview of the bivariate analysis carried out between peer attitudes towards maths and pupils disposition towards the Out-School value of Mathematics.

Table 53 – Peer attitudes towards mathematics

	Correlation coefficient	Sig
Peer Attitudes (SR)	.116	<.001
(SR) = Spearmans rho		

A Spearman's rho test identified a significant relationship between peer attitudes towards mathematics and pupils Out-School value of mathematics (p=<.001). The correlation coefficient indicates a weak positive relationship (.167) that provides evidence to suggest that the more positive attitudes peers have towards maths, the stronger pupils' disposition towards the Out-School value of mathematics. The null hypothesis is rejected.

Bivariate Summary

In summary, evidence suggests that pupil's disposition towards the Out-School value of mathematics is dependent on the following factors:

- Pupils' gender - Males have a stronger disposition towards the Out-School value of mathematics than females.
- Pupils' ethnicity - Those from a white background have a weaker disposition towards the Out-School value of mathematics than those from a Chinese and Black background. Those from a white background have a weaker disposition towards the out-school value of mathematics than any other ethnic group, except from those from a mixed background.
- Extra maths tuition – Those who have extra maths tuition see more Out-School value of mathematics than those that do not have extra maths tuition.
- Peer attitudes – Those who have peers that have positive attitudes towards maths have a stronger disposition towards the Out-School value of mathematics than those that have peers that have negative attitudes towards mathematics.

Mathematical Relevance

Mathematical relevance is the belief by pupils that they will use the mathematics they learn in school in everyday life. Table 54 provides an overview of the bivariate analysis carried out between pupils' demographic and socio-cultural factors on pupils' mathematical relevance, whereas table 55 provides an overview of parents' demographics and attitudes on mathematical relevance and table 56 provides an overview of the impact of peer attitudes on mathematical relevance. Mathematical relevance is measured on a scale of 1-6 with the higher the score, the more the pupils see the relevance of Mathematics.

Pupils' demographics on Mathematical Relevance

Table 54 – Pupils demographics on Mathematical Relevance

Impact of pupil demographics on Mathematical Relevance				
(A) = ANOVA (KW)= Kruskal Wallis (T)= t-Test (MW) = Mann Whitney (SR) = Spearmans rho				
IV	**N**	**Mean (Mean Rank)**	**df**	**Sig.**
Gender (MW)			2	.025
Male	988	833.57		
Female	637	781.10		
Ethnicity (KW)			4	<.001
White	817	719.10		
South Asian	450	834.26		
Chinese	33	966.18		
Black	168	876.59		
Mixed	83	682.55		
English as an Additional			N/A	<.001

Language (MW)				
Yes	717	889.92		
No	949	790.88		
Free School Meals (MW)			N/A	.718
Yes	519	826.30		
No	1145	835.31		
Maths tuition (MW)			N/A	<.001
Yes	143	999.05		
No	1533	823.52		
Parents help homework (MW)			N/A	.005
Yes	427	883.81		
No	1230	809.97		
Teacher gender (MW)			N/A	.053
Male	640	837.80		
Female	980	792.67		

Interpretation of table

Gender

A Mann Whitney test identified a significant difference (p=.025) when comparing pupils' gender and the relevance of mathematics. This provides evidence to suggest that males have a stronger disposition towards the relevance of mathematics (833.57) compared to females (781.10). The null hypothesis is rejected.

Ethnicity

A Kruskal Wallis test identified a significant difference (p=<.001) when comparing pupils' ethnicity and the relevance mathematics. Pairwise analysis found the biggest and most significant difference (p=<.001) between those from white (719.10) and Black (876.59) backgrounds. This provides evidence to suggest that those from a white background have a weaker disposition towards the relevance of mathematics than those from a Black background. The null hypothesis is rejected.

English as an Additional Language

A Mann Whiney test identified a significant difference (p=<.001) when comparing whether pupils speak English as an additional language and the relevance of mathematics. This provides evidence to suggest that those who speak English as an additional language have a weaker disposition towards the relevance of mathematics than those who do not speak English as an additional language. The null hypothesis is rejected.

Free School Meal eligibility

A Mann Whitney test did not identify a significant difference (p=.718) when comparing pupils free school meal eligibility and the relevance of mathematics. This provides evidence to suggest that free school meal eligibility does not affect pupils' disposition towards the relevance of mathematics. Therefore we fail to reject the null hypothesis.

Extra maths tuition

A Mann Whitney test identified a significant difference (p=<.001) when comparing whether pupils have extra maths tuition and the relevance of mathematics. This provides evidence to suggest that those who have extra maths tuition outside of school (999.05) see more relevance of mathematics than those that do not (823.52). The null hypothesis is rejected.

Parents help with homework

A Mann Whitney test identified a significant difference (p=.005) when comparing pupils who parents help them with their maths homework and the relevance of mathematics. This provides evidence to suggest that those who parents helped them with their maths homework have a stronger disposition towards the relevance of mathematics (883.81) than those who parents do not help them with their maths homework (809.97). Therefore we fail to reject the null hypothesis.

Teacher gender

A Mann Whitney test did not identify a significant difference (p=.053) when comparing pupils maths teachers' gender and the relevance of mathematics. This provides evidence to suggest that maths teacher gender does not affect pupils disposition towards the relevance of mathematics. Therefore we fail to reject the null hypothesis.

Parent demographics on pupils' relevance of mathematics

The impact of parent demographics and attitudes on pupils' relevance of mathematics is outlined below. Table 55 provides an overview of the bivariate analysis carried out between parents' demographic factors and attitudes towards maths on pupils' relevance of Mathematics.

Table 55 – Impact of parent demographics on pupils' relevance of mathematics

Impact of parent demographics on pupils' relevance of mathematics				
(A) = ANOVA (KW) = KRUSKAL WALLIS (T) = T-TEST (MW) = MANN WHITNEY (SR) = SPEARMANS RHO				
IV	**N**	**Mean (Mean Rank)**	**df**	**Sig.**
Gender (T)			314	.837
Male	87	2.32		
Female	229	2.37		
Ethnicity (A)			2	.008
White	195	2.04		
South Asian	126	2.71		
Black	30	3.00		
English as an Additional Language (T)			312	.482

Yes	145	2.45		
No	169	2.28		
Positive Parents Attitudes (SR)		.222		<.001

Interpretation of table

Gender

A *t*-Test did not identify a significant difference (p=.837) when comparing parents' gender and the pupils' relevance of mathematics. This provides evidence to suggest that parents gender does not affect pupils' disposition towards the relevance of mathematics. Therefore we fail to reject the null hypothesis.

Ethnicity

An ANOVA identified a significant difference (p=.008) when comparing parents' ethnicity and pupils' relevance of mathematics. Post hoc analysis identified a significant difference (p=.031) between those from a white (2.04) and South Asian (2.71) background. This provides evidence to suggest that those who parents are from a white background have a weaker disposition towards the relevance of mathematics compared to those who have parents from a South Asian background. The null hypothesis is rejected.

English as an additional language

A *t*-Test did not identify a significant difference (p=.482) when comparing whether parents speak English as an additional language and pupils' relevance of mathematics. This provides evidence to suggest that having parents that speak English as an additional language does not affect pupils' disposition towards the relevance of mathematics. Therefore we fail to reject the null hypothesis.

Positive parents' attitudes

A spearman's rho test identified a significant relationship between parents' positive attitudes and pupils Out-School value of mathematics (p=<.001). The correlation coefficient indicates a weak positive relationship (.222). This provides evidence to suggest that the more positive attitudes parents have towards mathematics, the stronger the disposition towards pupils' relevance of mathematics. The null hypothesis is rejected.

Peer Attitudes

The influence of peer attitudes on pupils' mathematical relevance is outlined below. Table 56 provides an overview of the bivariate analysis carried out between peer attitudes towards mathematics on pupils' relevance of Mathematics.

Table 56 – Peer attitudes towards mathematics

	Correlation coefficient	**Sig**
Peer Attitudes (SR)	.188	<.001
(SR) = Spearmans rho		

A Spearman's Rho test identified a significant relationship between peer attitudes towards maths and pupils' relevance of mathematics ($p=<.001$). The correlation coefficient indicates a weak positive relationship ($r = .188$) this provides evidence to suggest that the more positive attitudes peers have towards maths, the stronger the pupil's disposition towards the relevance of mathematics. The null hypothesis is rejected.

Bivariate Summary

In summary, evidence suggests that pupil's disposition towards the relevance of mathematics is dependent on the following factors:

- Gender - Males have a stronger disposition towards the relevance of mathematics than females.
- Pupil ethnicity - Those from a white background have a weaker disposition towards the relevance of mathematics than those from a black, South Asian and Chinese background. Those from a white background have a weaker disposition towards the relevance of mathematics than any other ethnic group.
- Speaking English as an additional language - Those who speak English as an Additional Language have a weaker disposition towards the relevance of

mathematics than those who do not speak English as an additional language.

- Pupils that receive extra maths tuition - Those who have extra maths tuition outside of school see more relevance in mathematics than those who do not have extra maths tuition.
- Pupils who parents help with their homework - Those who parents help them with their maths homework have a stronger disposition towards the relevance of mathematics than those who parents do not help them with their maths homework.
- Parents ethnicity – Those with parents that are black have a stronger disposition towards the relevance of mathematics than those from a South Asian or white background. Those from a white background have a weaker disposition towards the relevance of mathematics than any other ethnic group.
- Positive parents’ attitudes - Those who have parents with positive attitudes towards mathematics have a stronger disposition towards the relevance of mathematics than those who do not have parents with positive attitudes towards mathematics.
- Peer attitudes - Those who believe their peers have positive attitudes towards mathematics have a stronger disposition towards the relevance of mathematics than those who have peers with less positive attitudes towards mathematics.

Mathematical Confidence

Mathematical confidence refers to pupils’ belief in their ability to perform certain mathematical tasks from the Key stage 3 curriculum. Table 57 provides an overview of the bivariate analysis carried out between pupils’ demographic and socio-cultural factors on pupils’ mathematical confidence, whereas table 58 provides an overview of parents’ demographics and attitudes on mathematical confidence and table 59 provides an overview of the impact of peer attitudes on mathematical confidence. Mathematical confidence is measured on a scale of 6-60 with the higher the score, the stronger the pupil’s disposition towards their confidence in mathematics.

Table 57 – Impact of pupil demographics on pupils' Mathematical Confidence

Impact of pupil demographics on pupils Mathematical Confidence				
(A) = ANOVA (KW)= KRUSKAL WALLIS (T)= T-TEST (MW) = MANN WHITNEY (SR) = SPEARMANS RHO				
IV	**N**	**Mean (Mean Rank)**	**df**	**Sig.**
Gender (KW)			1	<.001
Male	952	42.51		
Female	621	38.81		
Ethnicity (A)			4	<.001
White	799	39.00		
South Asian	431	43.68		
Chinese	33	49.12		
Black	159	42.11		
Mixed	77	39.02		
English as an Additional Language (T)			1	.110
Yes	685	41.48		
No	931	40.58		
Free School Meals (T)			1	<.001
Yes	499	38.66		
No	1113	41.98		
Maths tuition (T)			1	.004
Yes	139	43.57		
No	1485	40.70		

Parents help homework (T)			1	<.001
Yes	412	39.19		
No	1194	41.54		
Teacher gender (T)			1	.078
Male	610	40.57		
Female	959	41.58		

Interpreting the table

Gender

A *t*-Test identified a significant difference (p=<.001) when comparing pupils' gender and mathematical confidence. This provides evidence to suggest that males (42.51) have a stronger disposition towards their mathematical confidence than females (38.81). The null hypothesis is rejected.

A *t*-Test did not identify a significant difference (p=<.078) when comparing pupils maths teachers' gender and mathematical confidence. This provides evidence to suggest that maths teachers gender does not affect pupils disposition towards their mathematical confidence. Therefore we fail to reject the null hypothesis.

Ethnicity

An ANOVA test identified a significant difference (p=<.001) when comparing pupils' ethnicity and mathematical confidence. Post hoc analysis found the biggest and most significant difference between white and Chinese (p=<.001) and white and South Asian (p=<.001). This provides evidence to suggest that those from a white ethnic background have a weaker disposition towards their mathematical confidence (39.00) compared to those from a South Asian (43.68) and Chinese background (49.12), with those from a Chinese background having the highest mathematical confidence than any other ethnic group. The null hypothesis is rejected.

English as an additional language

A *t*-Test did not identify a significant difference (p=<.110) when comparing whether pupils speak English as an additional language and mathematical confidence. This provides evidence to suggest that speaking English as ad additional language does not affect pupils' disposition towards their mathematical confidence. Therefore we fail to reject the null hypothesis.

Free school meal eligibility

A *t*-Test identified a significant difference (p=<.001) when comparing pupils free school meal eligibility and mathematical confidence. This provides evidence to suggest that those who are eligible for free school meals have a weaker disposition towards their mathematical confidence (38.66) than those who are not eligible for free school meals (41.98). The null hypothesis is rejected.

Extra maths tuition

A *t*-Test identified a significant difference (p=<.004) when comparing whether pupils have extra maths tuition and mathematical confidence. This provides evidence to suggest that those who do have extra maths tuition have more mathematical confidence (43.57) than those who do not have extra maths tuition (40.70). The null hypothesis is rejected.

Parents help with homework

A *t*-Test identified a significant difference (p=<.001) when comparing pupils who parents help them with their maths homework and mathematical confidence. This provides evidence to suggest that those who parents help them with their maths homework have a weaker disposition towards their mathematical confidence (39.19) than those who parents do not help them with their maths homework (41.54). The null hypothesis is rejected.

Parent demographics and attitudes on pupils' Mathematical Confidence

Parents influence on mathematical confidence is outlined below. Table 58 provides an overview of the bivariate analysis carried out between parents' demographic factors and attitudes towards mathematics on pupils' mathematical confidence.

Table 58 – Impact of parent demographics on pupils' Mathematical Confidence

Impact of parent demographics on pupils Mathematical Confidence				
(A) = ANOVA (KW)= KRUSKAL WALLIS (T)= T-TEST (MW) = MANN WHITNEY (SR) = SPEARMANS RHO				
IV	**N**	**Mean (Mean Rank) / correlation coefficient**	**df**	**Sig.**
Gender (T)			306	.368
Male	84	41.41		
Female	224	42.66		
Ethnicity (A)			2	<.001
White	166	40.11		
South Asian	99	45.22		
Black	26	43.30		
English as an Additional Language (T)			304	.304
Yes	141	43.12		
No	165	41.84		
Positive parent attitudes (SR)		.126		.033

Interpreting the table

Gender

A *t*-Test did not identify a significant difference (p=<.368) when comparing parents' gender and pupils' mathematical confidence. This provides evidence to suggest that parents gender do not affect pupils' disposition towards their mathematical confidence. Therefore we fail to reject the null hypothesis.

Ethnicity

An ANOVA test identified a significant difference (p=<.001) when comparing parents' ethnicity and pupils' mathematical confidence. Post hoc analysis found the most significant difference (p=<.001) between those from a White and South Asian background. This provides evidence to suggest that those who parents are from a White ethnic background (40.11) have a weaker disposition towards their mathematical confidence than those from a South Asian ethnic background (45.22). The null hypothesis is rejected.

English as an additional language

A *t*-Test did not identify a significant difference (p=.304) when comparing whether parents speak English as an additional language and pupils' mathematical confidence. This provides evidence to suggest that those who have parents that speak English as an additional language does not affect pupils' disposition towards their mathematical confidence. Therefore we fail to reject the null hypothesis.

Positive parent attitudes

A Spearman's rho test identified a statistically significant relationship between parents' positive attitudes and pupils mathematical confidence (p=.033). The correlation coefficient indicates a weak positive relationship (.126) which provides evidence to suggest that the more positive attitudes a parent has towards mathematics, the stronger the pupils' disposition towards their mathematical confidence. The null hypothesis is rejected.

Peer attitudes

Table 59 provides an overview of the bivariate analysis carried out between peer attitudes towards maths on pupils' mathematical confidence.

Table 59 – Peer attitudes towards mathematics

	Correlation coefficient	**Sig**
Peer Attitudes (SR)	.201	<.001
(SR) = SPEARMANS RHO		

A spearman's rho test identified a statistically significant relationship between peer attitudes towards mathematics and pupils' mathematical confidence (p=<.001).

The correlation coefficient indicates a weak positive relationship (.201) that provides evidence to suggest that the more positive attitudes peers have towards mathematics, the stronger pupils' disposition towards their mathematical confidence. The null hypothesis is rejected.

Bivariate Summary

In summary, evidence suggests that pupils' disposition towards their mathematical confidence is dependent on the following factors:

- Pupils gender - Males have a stronger disposition towards their mathematical confidence than females.
- Pupils' ethnicity - There was a significant difference between those from a white and Chinese background and those from a white and south Asian background. Those from a white background have a weaker disposition towards their mathematical confidence than any other ethnic group.
- Free school meal eligibility - Those eligible for free school meals have a weaker disposition towards their mathematical confidence than those who are not eligible for free school meals.
- Pupils who receive extra maths tuition - Those who have extra maths tuition have more confidence than those who do not have extra maths tuition.
- Pupils who parents help with homework - Those who parents help them with their maths homework have a weaker disposition towards their mathematical confidence than those who parents who do not help them with their maths homework.
- Parents ethnicity – Those pupils that have parents from a white ethnic background have a weaker disposition towards their mathematical confidence than those with parents from a South Asian ethnic background.
- Positive parent attitudes - Those who have parents with positive attitudes towards mathematics have a stronger disposition towards their confidence in mathematics than those who do not have parents with positive attitudes towards mathematics.
- Peer attitudes – Those that believe their peers have positive attitudes towards mathematics have a stronger disposition towards their

mathematical confidence than those that do not believe their peers have positive attitudes towards mathematics.

Discussing the bivariate analysis findings

Bivariate analysis is used extensively throughout government research (Richardson *et al*, 2020; Sizmu *et al*, 2019; ONS, 2022) to guide the decisions for many interventions and to identify and address inequalities within education and causes of disparities between groups and their educational successes. However, for this research bivariate analysis is useful for exploratory purposes only as it offers evidence of the use of the Harris Dispositional Framework and to understand the impact of different factors on each disposition and evidence that multivariate analysis is needed due to it taking multiple factors into account at any one time which is similar to the conditions pupils face each day where they are impacted by multiple factors at any one time such as their gender, ethnicity and free school meal eligibility.

Table 60: Overview of significant factors on each Mathematical disposition

Variables	**In-School value**	**Out-School value**	**Relevance**	**Confidence**
Gender		X	X	X
Ethnicity		X	X	X
English as an Additional Language	X		X	
Free School Meals	X			X
Extra maths tuition		X	X	X
Parents' help with maths homework			X	X
Teacher gender				

Parents' gender				
Parents' ethnicity				X
Parents – Speak English as an Additional Language				
Parents' attitudes			X	X
Peer attitudes	X	X	X	X

Table 60 identifies the significant factors on each Mathematical disposition: In-School value, Out-School value, relevance and confidence of mathematics.

Gender

When exploring how gender affects pupils' dispositions towards mathematics, gender had an impact on pupils Out-School value, relevance and confidence of mathematics. All findings indicated that males had stronger dispositions towards mathematics than females, indicating that males would have a stronger *Mathematical Habitus*, equalling better mathematical practices and educational outcomes than females (Bourdieu,1977; Edgerton *et al*, 2012). Although pre-1991 research suggested that males outperformed females (DfES, 2006), since then recent statistics show that females outperform males as 73.7% females achieve a grade 4 of above in mathematics compared with 67.1% males (Education Policy Institute, 2024). However, this measure uses grade 4 as the pass threshold, with the data not indicating what percentage of males and females achieve the highest grades in mathematics. This is reflected in recent applications in STEM subjects and careers due to mathematics being a gatekeeper for further study and future employment. Only 26% of females make up the STEM workforce, with a rapid growth of males graduating from STEM subject areas. increasing each year (McGee, 2024; Census, 2024). This indicates a disparity between what the data is showing from the percentage of males and females that pass GCSE mathematics, and those than then go on to further study and careers within mathematics.

Bashir *et al* (2023) found that attitudes towards mathematics differed between males and females when taking into account anxiety, confidence and the value and utility of mathematics. Bashir *et al* (2023) also found that parents had an impact on attitudes as generally they expected more from males than females, that Paechter (2001) argues plays into the role of gender stereotypes. Historically, mathematics was seen as a 'boys subject' due to the cultural acceptance of gender stereotypes that men were rational, and women were emotional (Paechter, 2001), with mathematics being an objective subject fell into this gendered stereotype.

Bourdieu (1990) indicates in his career and its system of determinations model how dispositions alongside demographics, social and cultural capital can impact access to qualifications, higher education and future careers. This highlights the importance of not looking at gender alone but together with other social and cultural factors, alongside dispositions to fully understand how gender can impact *Mathematical Habitus* and practices.

Ethnicity

When exploring the effect of ethnic groups on pupils' dispositions towards mathematics, there were significant differences between ethnic groups and pupils' strength of their dispositions towards the Out-School value, relevance and confidence of mathematics. Evidence suggests that across all three dispositions, Chinese have the strongest dispositions towards mathematics than any other ethnic group. This is in line with recent statistics that indicate 88.6% of Chinese pupils achieve a grade 4 or above compared with 64.6% of white pupils, with Chinese pupils ahead of British pupils by 27 months. (DfE, 2024). Chinese pupils' attainment gained lots of attention through TIMSS and PISA analysis that found that Chinese were top internationally for their attainment, which lead to the Teacher Exchange Programme in 2016. The intentions were that in China, the mastery method of teaching was enhancing Chinese pupils' attainment that must be adopted in the UK to increase mathematical attainment here. However, the evaluation report by Boylan *et al* (2019) found that the mastery method was not effective in increasing mathematical attainment and the need to look at how social and cultural factors impact attainment instead.

Ethnicity is closely linked with cultural practices, norms and expectations which Madood (2004) calls ethnic capital. Ethnic capital is influenced by parents', relatives' and community members' ambitions to achieve upwards social mobility, by the belief that education is important in achieving those ambitions. Furthermore, amongst all parental demographics, parents' ethnicity was the only factor that had an impact on any of the four dependent variables, with those pupils with parents from South Asian backgrounds having more mathematical confidence than any other ethnic group. Therefore, despite ethnic minorities being some of the most economically disadvantaged (CRE, 2021) their academic performance within mathematics education cannot be explained entirely by their ethnic background but instead their ethnic capital. Tomlinson (1991) found that despite performing less well than any other ethnic group, Black-Caribbean were more likely to stay in education, with the desire to stay in education and acquire qualifications far exceeding the desire of those who were white, which highlights the difference in ethnic groups and their attitudes towards education.

Attainment levels between ethnic groups have not always been like this, as prior to the late 1980's those from an ethnic minority background underperformed compared to those who were white. This was recognised by the Labour government by implementing the *Ethnic Minority Attainment Grant* 1999 aimed at those from ethnic minority background and those who speak English as an additional language. The Sutton Trust (2016) recognise the success of this intervention as the attainment gap has closed between those who are white and those from ethnic minority backgrounds, but instead a majority of ethnic minority groups now outperform those who are white. More recent national statistics show that Chinese outperform all ethnic groups in the UK (88.6% achieving a grade 4 and above), followed by South Asian, Black, then White (DfE, 2024).

Parents' ethnicity also has an impact on pupils' strength of their disposition towards their relevance and confidence of mathematics with those with parents from a white background having weaker dispositions towards the relevance of mathematics and their confidence in mathematics. This coincides with findings when looking at pupil ethnicity, as those who were Black had the strongest disposition towards the relevance of mathematics, followed by South Asian and then white, with those from a South Asian background having a stronger disposition towards their confidence in mathematics, followed by Black and then white. This suggests the transmission of values between parents that are closely linked with ethnicity due to the primary socialisation of pupils and their family *habitus,* which is affected by ethnicity and social class (Evans and Field, 2020; Roberts and Edgerton, 2014). Again, ethnicity should not be analysed alone, but in conjunction with other factors due to the impact other factors can have on ethnicity.

Speaking English as an Additional Language

When analysing what factors affect pupils' disposition towards the In-School value of mathematics, there were differences between those that speak and do not speak English as an Additional Language. Evidence suggests that those who speak English as an Additional Language have a weaker disposition towards the In-School value of mathematics, indicating that those that speak English as an additional language will have poorer mathematical practices and educational outcomes than those that do not speak English as an additional language (Bourdieu,1977; Edgerton *et al*, 2012). English as an additional language is a complex measure which is affected by many different factors such as time lived in England, the first language of the pupils, and language proficiency (DfE 2019; Strand *et al*, 2015). Mathematics requires a good level of reading comprehension and phonological processing (Fuchs *et al*, 2006) to be able to decipher texts to solve worded maths problems. Worded maths problems make up 20-30% of a GCSE maths paper that produces a barrier towards good mathematical attainment if pupils struggle with reading comprehension and phonological processing (Fuchs *et al*, 2006). Therefore, if pupils who speak English as an additional language struggle to understand and interpret mathematical questions, it becomes clear why their disposition towards the In-School value of mathematics may be weaker. If these pupils face difficulties in comprehending the language used in tasks, their ability to complete mathematical work is hindered. As a result, they may also struggle to see how what they are learning in the classroom will help them succeed in exams, particularly if they are aware that a certain level of language proficiency is required just to understand the questions being asked.

Evidence also suggests that speaking English as an additional language affects pupils' disposition towards the relevance of mathematics, where similarly those that spoke English as an additional language also had a weaker disposition towards the relevance of mathematics. It is evident again how language proficiency impacts pupils' dispositions towards mathematics, because if they struggle to understand the language in the classroom, then pupils will struggle to understand how they are going to use this in everyday life. A strong understanding of English and language proficiency, which Bourdieu (1986) calls linguistic capital, is needed to understand the key concepts of mathematical language used in classroom which is essential for success (Monaghan, 2016). Here, the cultural context of language is also important. Depending on the pupils first language and language spoken at home, can be a factor that impacts on pupils' academic achievement due to some similarities of some languages to English, but also the exposure to the language at home (Strand *et al,* 2015). The primary socialisation of pupils happens at home where values and attitudes can be transmitted from family members to pupils (Evans and Field, 2020).

It is important to highlight how EAL intersects with ethnicity, especially due to the *Ethnic Minority Attainment Grant* 1999 aimed at funding initiatives for pupils' that speak English as an additional language to improve their academic attainment due to its recognition of the intersection between ethnicity and speaking English as an additional language. The Department for Education (2019) recognised that the longer a pupil spends in the education system, the shorter the gap in attainment levels. According to Modood (2004) ethnic groups hold different cultural values and attitudes towards education that can impact pupils' educational attainment by the transmission of these values through primary socialisation (Evans and Field, 2020). Modood (2004) calls this ethnic capital which refers to a form of social capital consisting of norms and practices of individuals, families and communities which focuses on the transmission of aspirations, attitudes and norms enforcement. Therefore, multiple factors such as length of time in the country, language proficiency, and the transmission of attitudes, linked with ethnicity and parents, can have an impact on mathematical practice. This coincides with TIMSS

(2020) that found no significant difference between EAL and mathematical attainment due to the many factors that can influence attainment amongst those that speak English as an additional language (Richardson *et al*, 2020).

Overall, although it is important to understand how speaking English as an additional language impacts dispositions towards mathematics, it is also important to consider how this is measured and how it intersects with other factors such as class, ethnicity and parental values. Many of those that speak English as an additional language do well in mathematics, with those from a Chinese ethnic background outperforming any other ethnic group in England (DfE, 2024). This highlights that many other factors alongside the cultural context matters. Therefore, although bivariate analysis is important to allow for the exploration of these differences, multivariate must be used to fully understand which factors, when all analysed together, are the key predictors that have the most impact on pupils' dispositions towards mathematics.

Free School Meal Eligibility

Evidence suggests that there are differences between those pupils' that are and are not eligible for free school meals, and their dispositions towards mathematics. Those eligible for free school meals have weaker dispositions towards the In-School value of mathematics and their confidence in mathematics, indicating that those who are eligible for free school meals have a weaker *Mathematical Habitus* that equals weaker mathematical practices and educational outcomes, than those who are not eligible for free school meals (Bourdieu,1977; Edgerton *et al*, 2012). This is supported by Francis-Devine *et al* (2024) that found that 43% of pupils eligible for free school meals passed both English and Maths compared with 73% of those that were not eligible for free school meals, with those eligible for free school meals scoring lower in mathematical attainment (Richardson *et al*, 2020). The impact of free school meals on educational achievement has gained lots of attention over the years due to its relationships with poor educational outcomes. However, despite the wealth of literature suggesting that free school meal eligibility impacts educational attainment (The Sutton Trust 2024; ONS, 2021; Richardson *et al*, 2020), this research provides evidence to suggest that free school meal eligibility does not have an impact on all four dependent values as it does not affect pupils' dispositions towards the Out-School value and relevance of mathematics.

Free school meal eligibility, according to The Sutton Trust (2016) is a key factor of the attainment gap with much of their research focusing on how free school meal eligibility affects future outcomes. They emphasise the need to support those pupils who are eligible for free school meals to attain the same level as their peers that are not eligible for free school meals. The Office for National Statistics (2021) found that only half of those pupils that are eligible for free school meals go on to earn more than £17,000 aged 30, suggesting a relationship between free school meal eligibility and later income. When considering Bourdieu's (1990) educational career and its systems of determinations, initial class membership, alongside other social and cultural factors impact future careers, position in the societal hierarchy and eventual class membership.

This coincides with the use of free school meals as a proxy for social class, due to its links with socio-economic status that is widely used amongst educational research, policy and schools (Campbell and Cooper, 2024). However, it is also widely acknowledged how free school meal eligibility intersects with other social and cultural factors such as ethnicity, parents, speaking English as an additional language and peers. Therefore, looking at free school meal eligibility independently of any other factors does produce the narrative that those pupils that are eligible for free school meals perform less well in education, that goes on to impact their future careers and eventual social class. However, there is the need to look at how other factors may mitigate or exacerbate the effect of free school meal eligibility on *Mathematical Habitus* through regression analysis.

Extra Maths Tuition

This research suggests that those that receive extra maths tuition have stronger dispositions towards the Out-School Value, Relevance and Confidence of mathematics than those that do not receive extra tuition, indicating that those who receive extra maths tuition have a stronger *Mathematical Habitus* that equals stronger mathematical practices and educational outcomes, than those who do not receive extra maths tuition (Bourdieu,1977; Edgerton *et al*, 2012). This is supported by the Education Development Trust (20124) that suggests that extra tuition increased engagement in education which was a key factor in increasing the percentage of pupils that were working at or above the expected level from 18.4% to 61.2%. Furthermore, it is suggested that the impact of extra tuition is more evident across those from disadvantaged backgrounds, particularly those eligible for free school meals. The Sutton Trust (2024) highlights that tutoring is a key method of boosting academic achievement with significant socio-economic gaps in accessing private tutoring reducing due to the introduction of the National Tutoring Programme. The Sutton Trust (2024) highlight the importance of the National Tutoring Programme in minimising the attainment gaps between those eligible and not eligible for free school meals and unless this programme is renewed, there is the potential for this progress to go backwards.

This highlights a need for the continuation of the National Tutoring Programme that aims to address socio-economic disadvantages between pupils, as prior to the NTP majority of tutoring was accessed via private tutors from those affluent families that could afford private tuition (The Sutton Trust, 2017). Furthermore, extra tuition is common amongst East and South Asian countries, but not as common in England, showing differences in cultural norms and how this may impact international attainment levels (The Sutton Trust, 2017; Richardson *et al*, 2020). Therefore, according to this research, the targeted approach to those pupils from disadvantaged backgrounds seems beneficial, as those that received tuition had stronger dispositions towards mathematics.

Parents Help with Homework

This research provides evidence that parents that help their child with their homework has an impact mathematical relevance and confidence, indicating that this also has an impact on their *Mathematical Habitus* which equals mathematical practices and educational outcomes (Bourdieu,1977; Edgerton *et al*, 2012). However the impact of parents help with homework on dispositions is not linear. This research found that helping children with their maths homework increased pupils’ strength in their disposition towards mathematical relevance but decreased the strength in their disposition towards mathematical confidence, which supports Fiskerstrand and Hannula (2024) regarding the inconsistencies between the impact of parental help with homework. National Numeracy (2024) found that 23%

of parents found that helping their child with their maths homework makes them anxious, where this anxiety can be handed down from parents to children (National Numeracy, 2024; Evans and Field, 2020). This is contradictory to findings from the TIMSS 2019 report that found that parental support with homework positively influenced academic achievement (Richardson *et al*, 2020), however it is important to highlight that this was an international study. The Sutton Trust (2017) found that there was an 18% socio-economic gap between those parents that helped their child with their homework in England, compared to a 5% socio-economic gap between those in China. This supports the need for further research in this area to understand how parents may support or hinder pupils' outcomes in mathematics.

Peers' Attitudes

Evidence suggests that peer attitudes also have an effect on pupils' dispositions towards mathematics, with a positive relationship evidenced between all four dependent variables: In-School value, Out-School value, relevance and confidence. Those that have peers with more positive attitudes towards mathematics, have stronger dispositions towards mathematics, indicating that those with peers with positive attitudes towards mathematics have a stronger *Mathematical Habitus* which equals mathematical practices and educational outcomes, than those with peers with negative attitudes towards mathematics (Bourdieu,1977; Edgerton *et al*, 2012). This is supported by the Coleman Report (1966) that indicates peers are the most significant determinant of pupils' attainment apart from their own ability, which is evident as peer attitudes is the only variable that is significant across all four dependent variables. Ryan et al (2019) argue that peers' opinions and expectations about each other's Mathematical attainment matters for their own Mathematical attainment, with many possible reasons for this. One reason is that pupils develop close relationships with their peers due to seeing them most days and sharing the same activities, with this relationship then influencing behaviour and learning (Molloy *et al* 2011; Bakar *et al* 2021). Sokatch (2006) explains this relationship by using the human capital investment theory that pupils will decide whether to participate in certain activities based on the costs and benefits of the relationship with their peers.

Within the context of schools, peers do not only relate to those friendship groups, but also those peers which pupils' share their classrooms with. Bowles (1971) identifies that class subcultures arise from the everyday experiences of those members that are similar in personality, values and expectations, with Willis (1997) identifying how peers can have both a positive and negative effect on pupils attainment. Willis (1997) identified how the norms and values of a school setting did not align with the norms and values of 'the working-class lads' by them not understanding why other pupils would want qualifications due to experiencing their own parents without qualifications and gaining work in factories. Therefore, peer groups are a form of social capital, where those that have the norms and values that aligns with school (positive dispositions towards mathematics), have a stronger *Mathematical Habitus*, whereas those with peers with negative dispositions having a weaker *Mathematical Habitus*. Edgerton *et al* (2012) suggests that *habitus* equals practice, therefore the stronger the *habitus*, the stronger the mathematical practice that leads to positive educational outcomes. However, it is also important to acknowledge how the intersection of social class, parents, gender and ethnicity also influence this. Although the bivariate analysis has provided evidence of a relationship between peer attitudes towards mathematics and stronger pupils dispositions towards mathematics, other factors must also be considered alongside each other.

Parents attitudes

Evidence suggests that parents' attitudes towards mathematics impacts pupils' disposition towards the relevance and confidence of mathematics. Those with parents with more positive attitudes towards mathematics have stronger dispositions towards mathematics, showing a positive correlation between parents and pupils' dispositions towards mathematics. Evans and Field (2020) indicate that parents play an extremely important role in their child's educational success that can have both positive and negative effects. Cultural patterns, habits and skills are created and reinforced by parents during early socialisation that influences educational expectations and impacts on educational attainment (Lareau 2003; Dumais, 2002). Parents transmit their attitudes, interest, value and anxiety of mathematics that influences their child's involvement in educational practices and attainment (Evans and Field, 2020). This is supported by the evidence that positive parent attitudes increase pupils’ dispositions, however this did not have a significant effect on pupils’ disposition towards the In-School and Out-School value of mathematics. This suggests that other factors may have an impact, with Bodovski (2015) and Roberts and Edgerton (2014) indicating the intersection between parental expectation and social class. Bodovski (2015) identified that children raised in families of a higher social class have parents that expect more of them, with children from a higher social class believing they are more deserving and capable of a higher educational success than those from families of a lower social class, suggesting a difference in transmission of values (Evans and Field, 2020). Roberts and Edgerton (2014) believe that pupils’ educational practices come from their family *habitus* and cultural capital, where those values and attitudes that are transmitted from those of a middle class background hold more currency in formal institutions such as a schools, which translates to differences in educational outcomes. This coincides with Bourdieu and Passeron (1990) argument that children profit the most from parental cultural capital when the parent is of a higher social status, which better prepares them for higher levels of education and careers.

Despite the positive impacts of parent’s attitudes and values on pupils’ dispositions and attainment, parents can also have a negative effect (National Numeracy, 2024). This is not to blame the parents, this is an indication of how the structure of education favours those with middle class values, and those that have the social and cultural capital for the ‘rule of the game’ (Bourdieu, 1984) having a higher educational success.

Multivariate Analysis

This section presents the multivariate models used to assess the influence of pupils' demographics, teacher, parents and peers on pupils' dispositions towards their in-school value, out-school value, relevance and confidence of mathematics, with a final regression model measuring the impact on *Mathematical Habitus.* The purpose of this analysis is to investigate how each independent variable intersects and together impacts the four latent constructs. Multivariate analysis also allows for the complexity of *Mathematical Habitus* to be measured. This section then concludes with a multi-level model used to assess the impact of structures; type of school and classroom alongside pupil level measures on *Mathematical Habitus.*

Due to issues of multicollinearity between pupil and parent variables, parent gender, parent ethnicity and parents help with homework and pupil attitudes towards mathematics were not included in the models, and sue to a reduced model fit, extra maths tuition was also not included. The remaining eight variables were used to build five regression models and one multi-level model.

In-school Value

Table 61 – Model Summary

Adjusted R Square	0.7%
F Statistic	1.159
Df	8
Sig	.327

Table 62 – Regression Output

	B	**Std Error**	**Standardised coefficients beta**	**t**	**Sig**
Constant	5.163	.321		16.104	<.001
Gender	.032	.151	.016	.215	.830
EAL	-.324	.181	-.164	-1.785	.076
FSM	.130	.172	.057	.753	.452
South Asian	.373	.196	.183	1.906	.058
Black	-.011	.238	-.004	-.046	.963
Teacher gender	-.087	.159	-.042	-.544	.587
Parent attitudes	.022	.017	.099	1.300	.195
Peer attitudes	.027	.032	.064	.832	.406

Interpreting the table

The regression model containing gender, speaking English as an additional language, free school meal eligibility, ethnicity, pupils who have extra maths tuition, pupils who parents help with their homework, teacher gender, parent attitudes and peer attitudes is not significant (p=.327). The F statistic is below the threshold (1.159) therefore does not indicate a good model fit. The adjusted R square value (.007) indicates that the variables in the model contribute to 0.7% of the variance of the in-school value of mathematics. Therefore, due to the unreliability of the model to provide evidence of the predictors of In-School value of mathematics, there is no further analysis to be discussed. The we fail to reject the null hypothesis.

Regression Summary

Due to the unreliability of the model and the low variance of variables within the model, it is suggested other factors such as the school attended, and classroom may have an effect instead that supports the use of multi-level modelling to understand the impact of the classroom and school on pupils' mathematical practices.

Out-School Value

Table 63 – Model Summary

Adjusted R Square	6.4%
F statistic	2.524
Df	8
Significant	.013

Table 64 – Regression Output

	B	Std Error	Standardised coefficients beta	t	Sig
Constant	2.235	.667		3.351	<.001
Gender	.596	.313	.141	1.901	.059
EAL	-.308	.377	-.073	-.816	.416
FSM	-.315	.359	-.065	-.879	.381
South Asian	.024	.408	.005	.058	.954
Black	.863	.495	.138	1.742	.083
Teacher gender	-.094	.331	-.021	-.283	.777
Parents attitudes	.032	.035	.068	.914	.362
Peer attitudes	.186	.066	.2105	2.807	.006

Interpreting the table

The regression model containing gender, speaking English as an additional language, free school meal eligibility, ethnicity, teacher gender, positive parent attitudes and peer attitudes is significant (p=.013). The F statistic (2.524) shows below the threshold; therefore, the critical value is calculated using the degrees of freedom and significance value that indicates an F value of 2.02 or above is sufficient for good model fit. The adjusted R square value (.064) indicates that these variables contribute to 6.4% of the variance of out-school value of mathematics. The null hypothesis 6 is rejected.

The unstandardized regression coefficient for gender (B=.596; p=.059) indicates that gender is not a statistically significant factor on influencing pupils' disposition towards the out-school value of mathematics when controlling for all other variables in the model. This provides evidence to suggest that being male increases pupil's disposition towards the out-school value by .596 on the out-school value scale, however this finding is not statistically significant (p=.059)

The unstandardized regression coefficient for speaking English as an additional language (B=-.308; p=.416) indicates that speaking English as an additional language is not a statistically significant factor on influencing pupils out-school value of mathematics when controlling for all other variables in the model. This provides evidence to suggest that speaking English as an additional language decreases pupil's disposition towards the out-school value by -.308 on the out-school value scale, however this finding is not statistically significant (p=.416).

The unstandardized regression coefficient for free school meal eligibility (B=-.315; p=.381) indicates that free school meal eligibility is not a statistically significant factor on influencing pupil's disposition towards the out-school value of mathematics when controlling for all other variables in the model. This provides evidence to suggest that being eligible for free school meals decreases Out-School value by -.456 on the out-school value scale, however this finding is not statistically significant (p=.381).

The unstandardized regression coefficient for ethnicity (South Asian; B=-.024; p=.954: Black; B=.863; p=.083) indicates that ethnicity is not a statistically significant factor on influencing pupil's disposition towards the out-school value of mathematics when controlling for all other variables in the model. This provides evidence to suggest that that being South Asian decreases pupil's disposition towards the out-school value by .321 and being black increases pupil's disposition towards the out-school value by .555 on the out-school value scale when comparing to the white population, however this finding is not statistically significant (p=.954; p=.083).

The unstandardized regression coefficient for teacher gender (B=-.094; p=.777) indicates that teacher gender is not a statistically significant factor on influencing pupil's disposition towards the out-school value of mathematics when controlling for all other variables in the model. This provides evidence to suggest that having a female teacher decreases pupil's disposition towards the out-school value by -.050 on the out-school value scale, however this finding is not statistically significant (p=.777).

The unstandardized regression coefficient for positive parent attitudes (B=.032; p=.362) indicates that parent attitudes is not a statistically significant factor on influencing pupil's disposition towards the out-school value of mathematics when controlling for all other variables in the model. This provides evidence to suggest that having parents with positive attitudes towards mathematics increases pupil's disposition towards the out-school value by .016 on the out-school value scale, however this finding is not statistically significant (p=.362).

The unstandardized regression coefficient for peer attitudes towards maths (B=.186; p=.006) indicates that those who believe their peers have positive attitudes towards maths have a stronger disposition towards the out-school value of mathematics when controlling for all other variables in the model. Those who believe their peers have positive attitudes towards maths score .143 more on the out-school value scale than those that do not believe their peers have positive attitudes towards maths. This provides evidence to suggest that peer attitudes are a key predictor of pupils Out-School value of mathematics.

Regression Summary

When identifying the most influential factors on pupils' disposition towards the Out-School value of mathematics, of the eight predictors associated with pupils Out-School value of mathematics, peer attitudes is the only key predictor of a stronger disposition towards the Out-School value of mathematics. Those pupils that believe their peers have positive attitudes towards mathematics score .143 more on the out-school value scale. This provides evidence to suggest that pupils gender and ethnicity, all that were significant in bivariate analysis, do not influence pupils' disposition towards the Out-School value of mathematics when considering the influence of multiple factors simultaneously. This captures the complexity of the influences on pupils' disposition towards the Out-School value of mathematics within the context of the school environment.

Mathematical Relevance

Table 65 – Model Summary

Adjusted R Square	4.7%
F statistic	2.092
Df	8
Significance	.039

Table 66 – Regression Output

	B	**Std Error**	**Standardised coefficients beta**	**t**	**Sig**
Constant	.538	.634		.850	.397
Gender	.237	.298	.060	.797	.427
EAL	.389	.358	.097	1.085	.280
FSM	-.219	.341	-.048	-.643	.521
South Asian	.140	.387	.034	.362	.718
Black	.553	.470	.094	1.176	.241
Teacher gender	-.226	.314	-.054	-.719	.473
Parent attitudes	.079	.033	.179	2.400	.017
Peer attitudes	.091	.063	.110	1.451	.149

Interpreting the table

The regression model containing gender, speaking English as an additional language, free school meal eligibility, ethnicity, teacher gender, positive parent attitudes and peer attitudes is significant (p=.039). The F statistic (2.092) shows below the threshold; therefore, the critical value is calculated using the degrees of freedom and significance value that indicates an F value of 2.02 or above is sufficient for good model fit. The adjusted R square value (.047) indicates that these variables contribute to 4.7% of the variance of Mathematical relevance. The null hypothesis 7 is rejected.

The unstandardized regression coefficient for gender (B=-.237; p=.427) indicates that gender is not a statistically significant factor on influencing pupils' disposition towards the relevance of mathematics when controlling for all other variables in the model. This provides evidence to suggest that being male increases mathematical relevance by .237 on the scale, however this finding is not statistically significant (p=.427).

The unstandardized regression coefficient for speaking English as an additional language (B=.389; p=.280) indicates that speaking English as an additional language is not a statistically significant factor on influencing pupil's disposition towards the relevance of mathematics when controlling for all other variables in model. This provides evidence to suggest that speaking English as an additional language increases mathematical relevance by .389 on the mathematical relevance scale, however this finding is not statistically significant (p=.280).

The unstandardized regression coefficient for free school meal eligibility (B=-.219; p=.521) indicates that free school meal eligibility is not a statistically significant factor on influencing pupil's disposition towards the relevance of mathematics when controlling for all other variables in the model. This provides evidence to suggest that being eligible for free school meals decreases mathematical relevance by .219 on the mathematical relevance scale, however this finding is not statistically significant (p=.521).

The unstandardized regression coefficient for ethnicity (South Asian; B=.140; p=.718: Black; B=.553; p=.241) indicates that ethnicity is not a statistically significant factor on influencing pupil's disposition towards the relevance of mathematics when controlling for all other variables in the model. This provides evidence to suggest that being South Asian increases mathematical relevance by .140 and being black increases mathematical relevance by .553 on the mathematical relevance scale when comparing to the white population, however finding is not statistically significant (p=.718; p=.241).

The unstandardized regression coefficient for teacher gender (B=-.226; p=.473) indicates that teacher gender is not a statistically significant factor on influencing pupil's disposition towards the relevance of mathematics when controlling for all other variables in the model. This provides evidence to suggest that having a female teacher decreases mathematical relevance by .226 on the mathematical relevance scale, however this finding is not statistically significant (p=.473).

The unstandardized regression coefficient for parent attitudes (B=.079; p=.017) indicates that parent attitudes is a statistically significant factor on influencing pupil's disposition towards the relevance of mathematics when controlling for all other variables in the model. This provides evidence to suggest that having parents with positive attitudes towards mathematics increases Out-School value by .079 on the mathematical relevance scale and is statistically significant (p=.017).

The unstandardized regression coefficient for peer attitudes towards maths (B=.091; p=.149) indicates that those who believe their peers have positive attitudes towards maths have a stronger disposition towards the relevance of mathematics when controlling for all other variables in the model. Those who believe their peers have positive attitudes towards maths score .091 more on the mathematical relevance scale than those that do not believe their peers have positive attitudes towards maths, however this finding is not statistically significant (p=.149).

Regression Summary

When identifying the most influential factors on pupil's disposition towards the relevance of mathematics, of the eight predictors associated with mathematical relevance, only those pupils that have parents with positive attitudes towards mathematics was the main predictor of impacting pupils' relevance of mathematics. Those pupils with parents with positive attitudes towards mathematics score .079 more on the relevance scale. This provides evidence to suggest that gender, ethnicity, speaking English as an additional language, and those that believe their peers have positive attitudes towards mathematics, all that were significant in bivariate analysis, do not influence pupil's disposition towards the relevance of mathematics when considering the influence of multiple factors simultaneously. This captures the complexity of influences on pupils' mathematical relevance within the context of school.

Mathematical Confidence

Table 67 – Model Summary

Adjusted R Square	12.7%
F Statistics	4.236
Df	8
Significance	<.001

Table 68 – Regression Output

	B	**Std Error**	**Standardised coefficients beta**	**t**	**Sig**
Constant	33.612	3.141		10.700	<.001
Gender	4.524	1.459	.223	3.100	.002
EAL	-3.064	1.752	-.151	-1.749	.082
FSM	2.158	1.665	.093	1.296	.197
South Asian	5.655	1.891	.270	2.990	.003
Black	2.965	2.298	.099	1.290	.199
Teacher gender	.575	1.546	.027	.372	.710
Parents attitudes	.104	.161	.046	.646	.519

Peer attitudes	.727	.310	.170	2.349	.020

Interpreting the table

The regression model containing gender, speaking English as an additional language, free school meal eligibility, ethnicity, teacher gender, positive parent attitudes and peer attitudes is significant (p=<.001). The F statistic (4.236) shows below the threshold therefore the critical value is calculated using the degrees of freedom and significance value that indicates an F value of 2.66 or above is sufficient for good model fit. The adjusted R square value (.127) indicates that these variables contribute to 12.7% of the variance of Mathematical confidence. The null hypothesis 8 is rejected.

The unstandardized regression coefficient for gender (B=4.524; p=.002) indicates that gender is a statistically significant factor on influencing pupil's disposition towards their mathematical confidence when controlling for all other variables in the model. This provides evidence to suggest that those who are male score 4.524 higher on the mathematical confidence scale than those who are female and is significant (p=.002).

The unstandardized regression coefficient for speaking English as an additional language (B=-3.064; p=.082) indicates that speaking English as an additional language is not a statistically significant factor on influencing pupil's disposition towards their mathematical confidence when controlling for all other variables in the model. This provides evidence to suggest that speaking English as an additional language decreases mathematical confidence by 3.064 on the mathematical confidence scale, however this finding is not statistically significant (p=.082).

The unstandardized regression coefficient for free school meal eligibility (B=2.158; p=.197) indicates that free school meal eligibility is not a statistically significant factor on influencing pupil's disposition towards their mathematical confidence when controlling for all other variables in the model. This provides evidence to suggest that being eligible for free school meals increases mathematical confidence by 2.158 on the mathematical confidence scale, this finding is not statistically significant (p=.197).

The unstandardized regression coefficient for ethnicity (South Asian; B=5.655; p=.003: Black; B=2.965; p=.199) indicates that ethnicity is a key factor on influencing pupil's disposition towards their mathematical confidence as being South Asian is significant (p=.003) whereas being black is not (p=.199) when controlling for all other variables in the model. This provides evidence to suggest that being South Asian increases mathematical confidence by 5.655 and being black increases mathematical confidence by 2.965 on the mathematical confidence scale when compared to the white population. This finding is only statistically significant for the South Asian ethnic group (p=.003).

The unstandardized regression coefficient for teacher gender (B=.575; p=.710) indicates that teacher gender is not a statistically significant factor on influencing pupil's disposition towards their mathematical confidence when controlling for all other variables in the model. This provides evidence to suggest that having a female teacher increases mathematical confidence by .575 on the mathematical confidence scale, however this finding is not statistically significant (p=.710).

The unstandardized regression coefficient for parent attitudes (B=.104; p=.519) indicates that parent attitudes is not a statistically significant factor on influencing pupil's disposition towards their mathematical confidence when controlling for all other variables in the model. This provides evidence to suggest that having parents with positive attitudes towards mathematics increases mathematical confidence by .104 on the mathematical confidence scale, this finding is not statistically significant (p=.519).

The unstandardized regression coefficient for peer attitudes towards maths (B=.727; p=.020) indicates that those who believe their peers have positive attitudes towards maths have a stronger disposition towards their mathematical confidence when controlling for all other variables in the model. Those who believe their peers have positive attitudes towards maths score .727 more on the mathematical confidence scale than those that do not believe their peers have positive attitudes towards maths, this finding is statistically significant (p=.020).

Regression summary

When identifying the most influential factors of the eight predictors associated with pupil's disposition towards their mathematical confidence, being male, South Asian and having the belief that their peers have positive attitudes towards mathematics are key predictors of mathematical confidence whilst considering the influence of all other variables in the model. This provides evidence to suggest that pupils mathematical confidence is affected by gender, ethnicity and peers as those who are male score 4.524 higher than females, South Asian score 5.655 more than those from a white ethnic background and those with peers with positive attitudes towards mathematics increases mathematical confidence by .727 for every increment on the mathematical confidence scale. Moreover, this also provides evidence to suggest that free school meal eligibility and positive parent attitudes, all that were significantly associated with mathematical confidence in the bivariate analysis, are not key predictors of mathematical confidence when considering the other factors simultaneously. This captures the complexity of influences on pupils' disposition towards their mathematical confidence within the context of school.

Mathematical Habitus

Mathematical Habitus refers to a set of dispositions (in-school value, out-school value, relevance and confidence) that influences mathematical practice and are affected by a pupil's demographics, social capital, cultural capital and their environment, including parents and peers dispositions towards mathematics. Table 69 and 70 provides a summary of the regression analysis.

Table 69 – Model Summary

Adjusted R Square	14.7%
F statistic	4.841
Df	8
Significant	<.001

Table 70 – Regression Output

	B	Std Error	Standardised coefficients beta	t	Sig
Constant	39.238	3.752		10.458	<.001
Gender	4.848	1.763	.195	2.751	.007
EAL	-2.984	2.123	-.119	-1.406	.162
FSM	1.967	2.019	.069	.974	.331
South Asian	6.186	2.293	.240	2.698	.008
Black	4.590	2.786	.125	1.648	.101
Teacher gender	.971	1.861	.037	.521	.603
Parents attitudes	.297	.195	.108	1.523	.130
Peer attitudes	1.165	.373	.223	3.120	.002

The regression model containing gender, speaking English as an additional language, free school meal eligibility, ethnicity, teacher gender, positive parent attitudes and peer attitudes is significant (p=<.001). The F statistic (4.841) shows below the threshold; therefore, the critical value is calculated using the degrees of freedom and significance value that indicates an F value of 2.66 or above is sufficient for good model fit. The adjusted R square value (.147) indicates that these variables contribute to 14.7% of the variance of *Mathematical Habitus*. The null hypothesis 9 is rejected.

The unstandardized regression coefficient for gender (B=4.848; p=.007) indicates that gender is a statistically significant factor on influencing *Mathematical Habitus* when controlling for all other variables in the model. Those who are male score 4.848 higher on the *Mathematical Habitus* scale than females.

The unstandardized regression coefficient for speaking English as an additional language (B=-2.984; p=.162) indicates that speaking English as an additional language is not a statistically significant factor on influencing pupil's *Mathematical Habitus* when controlling for all other variables in the model. Although the beta coefficient suggests that speaking English as an additional language decreases *Mathematical Habitus* by -2.984 on the *Mathematical Habitus* scale, this finding is not statistically significant (p=.162) therefore findings are to be treated with caution and not generalised to the whole population.

The unstandardized regression coefficient for free school meal eligibility (B=1.967; p=.331) indicates that free school meal eligibility is not a statistically significant factor on influencing pupils' *Mathematical Habitus* when controlling for all other variables in the model. Although the beta coefficient suggests that being eligible for free school meals increases *Mathematical Habitus* by 1.967 on the *Mathematical Habitus* scale, this finding is not statistically significant (p=.331) therefore findings are to be treated with caution and not generalised to the whole population.

The unstandardized regression coefficient for ethnicity (South Asian; B=6.186; p=.008: Black; B=4.590; p=.101) indicates that ethnicity is a statistically significant factor on influencing pupils *Mathematical Habitus* when controlling for all other variables in the model. The beta coefficient suggests that being South Asian increases *Mathematical Habitus* by 6.186 and is statistically significant (p=.008), whereas being black increases *Mathematical Habitus* by 4.590 on the *Mathematical Habitus* scale and is not statistically significant (p=.101) when compared to the white population.

The unstandardized regression coefficient for teacher gender (B=.971; p=.603) indicates that teacher gender is not a statistically significant factor on influencing pupils *Mathematical Habitus* when controlling for all other variables in the model. Although the beta coefficient suggests that having a female teacher increases mathematical confidence by .971 on the *Mathematical Habitus* scale, this finding is not statistically significant (p=.603) therefore findings are to be treated with caution and not generalised to the whole population.

The unstandardized regression coefficient for parent attitudes (B=.297; p=.130) indicates that parent attitudes is not a statistically significant factor on influencing pupil's *Mathematical Habitus* when controlling for all other variables in the model.

Although the beta coefficient suggests that having parents with positive attitudes towards mathematics increases *Mathematical Habitus* by .297 on the *Mathematical Habitus* scale, this finding is not statistically significant ($p=.130$) therefore findings are to be treated with caution and not generalised to the whole population.

The unstandardized regression coefficient for peer attitudes towards maths ($B=1.165$; $p=.002$) indicates that those who have peers with positive attitudes towards maths have more *Mathematical Habitus* when controlling for all other variables in the model. Those who have peers that have positive attitudes towards maths score 1.165 more on the *Mathematical Habitus* scale than those that do not believe their peers have positive attitudes towards maths, and is statistically significant ($p=.002$).

Regression summary

When identifying the most influential factors of the eight predictors associated with *Mathematical Habitus*, being male, South Asian and having peers that have positive attitudes towards mathematics were found to positively influence mathematical *habitus* whilst considering the influence of all other variables in the model. All variables contribute to 14.7% of the variance in the model. This provides evidence to suggest that pupils *Mathematical Habitus* is significantly affected by gender, ethnicity and peer attitudes towards mathematics when taking into account all other factors. Therefore, focus should be given to those who are female, from other ethnic backgrounds and those with peers with negative attitudes towards mathematics to enhance their dispositions towards mathematics, that makes up their *Mathematical Habitus* and has an effect on mathematical practice.

Key predictors of influences on *Mathematical Habitus*

<u>Table 71 – Significant predictor of a stronger *Mathematical Habitus*</u>

Variable	In-School value	Out-School value	Relevance	Confidence	Mathematical Habitus
Gender				X	X
EAL					
FSM					
South Asian				X	X
Black					
Teacher gender					
Parents attitudes			X		
Peer attitudes		X		X	X

Table 71 provides an overview of the significant predictors of *Mathematical Habitus* across all five regression models. It is evident that different factors have a different effect on each of the dispositions towards mathematics. When separately taking each disposition into account, the model containing in-school value did not provide a good model fit which indicates there may be other factors that are not in the model that have an effect. When analysing the model containing out-school value, only peer attitudes was the key predictor of a stronger Out-School disposition towards mathematics. Peer attitudes was the most significant predictor of out-school value, confidence and *Mathematical Habitus* overall, suggesting that more attention should be given to this factor.

Parents' attitudes were only significant when analysing the model containing mathematical relevance, with being male and South Asian being significant across mathematical confidence and *Mathematical Habitus*. Overall, this provides evidence of the use of the Harris Dispositional Framework to understand they key predictors that impact *Mathematical Habitus.*

Multi-Level Model

This section presents the analysis of three multi-level models used to analyse the clustering effect of schools and the classroom on pupils' *Mathematics Habitus* when taking into account pupil level characteristics.

Table 72: Overview of multi-level model outputs

	Model 1	**Model 2**	**Model 3**
Residual variance	184.858 *	113.712*	111.215*
Intercept variance (school level)	13.252	4.908	
Intra-class correlation	6%	9.5%	
Log Likelihood	1365.09	1335.94	1346.50
*p<.001 Significance			

The unconditional model yielded a significant residual variance (<.001), however the intercept variance was not significant (.057). The intra-class correlation (.06) indicates that 6% of the total variance in *Mathematical Habitus* is accounted for by the school which the pupil attends, however as this is not statistically significant therefore we fail to reject the null hypothesis.

Model 2: School influence on *Mathematical Habitus* with pupil level variables

The conditional model yielded a significant residual variance (<.001), however the intercept variance was not significant (.711). The intra-class correlation (.95) indicates that 9.5% of the total variance in *Mathematical Habitus* is accounted for by the school when considering the influence of pupil level characteristics.

However, this is not statistically significant therefore we fail to reject the null hypothesis.

Table 73: Multilevel model output

	Estimate	Std error	df	t	Sig	Lower Bound	Upper Bound
Intercept	57.047	6.031	101.475	9.459	<.001	45.084	69.010
Gender (male)	5.342	1.750	129.976	3.052	.003	1.879	8.804
Ethnicity (South Asian)	-7.577	2.503	37.941	-3.027	.004	-12.645	-2.509
Ethnicity (Black)	-2.037	2.834	91.376	-.719	.474	-7.665	3.591
FSM	1.242	1.921	169	.647	.519	-2.550	5.034
EAL	-3.812	2.020	169.000	-1.887	.061	-7.800	.177
Teacher gender	-.549	1.822	151.498	-.301	.764	-4.148	3.050
Teacher ID	-.069	.039	20.804	-1.769	.092	-.149	.012
Peer Attitudes	.808	.363	163.822	2.227	.027	.092	1.524
Parent Attitudes	.253	.185	166.050	1.362	.175	-.114	.619

The unstandardised regression coefficient for gender (B=5.342, P=.001) indicates that gender affects *Mathematical Habitus* as males score 5.342 more on the *Mathematical Habitus* scale than females when taking into account the influence of the school and controlling for all other variables in the model. This provides evidence to suggest that males have stronger dispositions towards mathematics that increases their *Mathematical Habitus.*

The unstandardised regression coefficient for ethnicity (South Asian B=-7.577, P=.005; B=-2.037, P = .474) indicates that ethnicity affects *Mathematical Habitus* as those who are South Asian score 7.577 less on the *Mathematical Habitus* scale than any other ethnic group when taking into account the influence of the school and controlling for all other variables in the model. This provides evidence to suggest that those who are South Asian have weaker dispositions towards mathematics than any other ethnic group that decreases their *Mathematical Habitus.*

The unstandardised regression coefficient for free school meal eligibility (B=1.242, P=.519) indicates that free school meal eligibility does not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

The unstandardised regression coefficient for speaking English as an additional language (B=-3.812, P=.061) indicates that speaking English as an additional language does not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

The unstandardised regression coefficient for teacher gender (B=-.549, P=.764) indicates that teacher gender does not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

The unstandardised regression coefficient for the effect of the teacher (teacher ID) (B=-.069 P=.092) indicates that the teacher does not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

The unstandardised regression coefficient for peer attitudes (B=-.808, P=.027) indicates that peer attitudes affect *Mathematical Habitus* as with each increase of a positive peer attitudes, it increases *Mathematical Habitus* by .808 on the scale when taking into account the influence of the school and controlling for all other variables in the model. This provides evidence to suggest that those who have peers with positive attitudes towards mathematics have stronger dispositions towards mathematics that increases their *habitus*.

The unstandardised regression coefficient for parent attitudes (B=-.253, P=.175) indicates that parent attitudes do not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

Design effect of the model

The design effect of the model was calculated to ensure an appropriate sample size for analysis and reliable findings. Post hoc power analysis was used to identify the reliability and appropriate sample size needed to conduct this analysis that could identify the impact of the school, alongside pupils level factors on pupils' *Mathematical Habitus* (Donner, Birkett and Buck, 1981).

Formula: DE = 1 + (n-1) p
Where: n = average clustering size (sample size/cluster) ; p= ICC

n = (1698/10 = 169.8) and p = (0.06)

DE = 1 + (169.8 – 1)*0.06
DE = 1 + 168.8*0.06
DE = 1 + 10.128
DE = 11.128

The appropriate sample to conduct this analysis is calculated by multiplying the cluster size (10) by the design effect (11.128). Therefore, the model requires 111 schools, 18,895 pupils (sample size multiplied by design effect) with approximately 169 teachers needed for the model to be reliable. Therefore, for this research findings from the multiple regression model will be used instead.

Model 3: School and teacher influence on *Mathematical Habitus* with pupil level variables

The second conditional model yielded a significant residual variance (<.001), however the intercept variance could not be computed due to an inadequate sample size. Therefore, post hoc power analysis is used to identify the appropriate sample size needed to conduct this analysis (Donner, Birkett and Buck, 1981).

Table 74: Multi level model output

	Estimate	Std error	df	t	Sig	Lower Bound	Upper Bound
Intercept	61.472	13.839	169	4.442	<.001	34.151	88.792
Gender (male)	5.753	1.794	169	3.206	.002	2.211	9.295
Ethnicity (South Asian)	-9.583	2.636	169	-3.636	<.001	-14.786	-4.380
Ethnicity (Black)	-.361	2.954	169	-.122	.903	-6.192	5.471
FSM	1.261	1.927	169	.654	.514	-2.544	5.065
EAL	-4.587	2.031	169	-2.259	.025	-8.596	-.578
Teacher Gender	-.706	1.889	169	-.374	.709	-4.435	3.023
Teacher ID	-.129	.196	169	-.659	.511	-.516	.258
Peer Attitudes	.741	.361	169	2.052	.042	.028	1.454
Parent Attitudes	.187	.186	169	1.009	.315	-.179	.554

The unstandardised regression coefficient for gender (B=5.753, P=.00) indicates that gender affects *Mathematical Habitus* as males score 5.753 more on the *Mathematical Habitus* scale than females when taking into account the influence of the school and teacher when controlling for all other variables in the model. This provides evidence to suggest that males have stronger dispositions towards mathematics that increases their *Mathematical Habitus.*

The unstandardised regression coefficient for ethnicity (South Asian B=-9.583, P=.005; Black B=-.361, P = .903) indicates that ethnicity *affects Mathematical Habitus* as those who are South Asian score 9.583 less on the *Mathematical Habitus* scale than any other ethnic group when taking into account the influence of the school and teacher when controlling for all other variables in the model. This provides evidence to suggest that those who are South Asian have weaker dispositions towards mathematics than any other ethnic group that decreases their *Mathematical Habitus.*

The unstandardised regression coefficient for free school meal eligibility (B=1.261, P=.514) indicates that free school meal eligibility does not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

The unstandardised regression coefficient for speaking English as an additional language (B=-4.587, P=.025) indicates that speaking English as an additional language affects *Mathematical Habitus* by scoring 4.587 less on the mathematical *habitus* scale than those who do not speak English as an additional language when taking into account the influence of the school and teacher when controlling for all other variables in the model. This provides evidence to suggest that speaking English as an additional language have weaker dispositions towards mathematics that decreases their *Mathematical Habitus*.

The unstandardised regression coefficient for teacher gender (B=-.706, P=.764) indicates that teacher gender does not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

The unstandardised regression coefficient for the effect of the teacher (teacher ID) (B=-.129 P=.511) indicates that the teacher does not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

The unstandardised regression coefficient for peer attitudes (B=-.741, P=.042) indicates that peer attitudes affect *Mathematical Habitus* as with each increase of a positive peer attitudes, it increases pupils' *Mathematical Habitus* by .741 on the scale when taking into account the influence of the school and teacher when controlling for all other variables in the model. This provides evidence to suggest that those who have peers with positive attitudes towards mathematics have stronger dispositions towards mathematics that increases their *habitus*.

The unstandardised regression coefficient for parent attitudes (B=-.187, P=.315) indicates that parent attitudes do not affect *Mathematical Habitus* when taking into account the influence of the school and controlling for all other variables in the model.

Design effect of the model

To estimate the design effect, reliability and appropriate sample size to conduct this analysis, post hoc power analysis is used to measure the impact of schools and classrooms on pupils' *Mathematical Habitus* (Donner, Birkett and Buck, 1981).

N = average clustering size (1698/75 = 22.64) and p = ICC (0.95)

DE = 1 + (22.64 – 1)*0.95
DE = 1 + 21.64*0.95
DE = 1 + 20.55
DE = 21.55

The appropriate sample to conduct this analysis is calculated by multiplying the cluster size (75) by the design effect (21.55). Therefore, the model requires 1616 classrooms, 36,591 pupils (sample size multiplied by design effect) with approximately 23 pupils per classroom needed to conduct the model and for it to be reliable. Therefore, for the research findings from the multiple regression model will be used instead.

Summary of analysis

In summary, bivariate analysis served as an initial exploratory tool to examine how group differences such as gender, ethnicity, and free school meal eligibility relate to four key dispositions towards mathematics: in-school value, out-of-school value, relevance, and confidence. However, these findings are limited to exploratory insights due to the lack of consideration for the intersectionality between variables. To address this, multivariate analysis methods were used to account for the combined effect of multiple factors within the model, allowing for the identification of significant predictors influencing *Mathematical Habitus.*

Subsequently, multi-level modelling was introduced to assess the influence of structural factors, such as the school and classroom effects on *Mathematical*

Habitus. However, this method did not yield reliable results due to an insufficient sample size. Calculation of the design effect highlighted the necessity of a larger, nationally representative sample to capture the school and classroom level influences.

Overall, regression analysis proved effective in identifying key predictors of *Mathematical Habitus* and demonstrated the utility of applying the Harris dispositional framework to quantitatively measure this construct.

Chapter 6: Key Findings

This section discusses the key findings of this research with an exploration of its limitations, the need for further study and concluding remarks.

There are six key findings of this research:

Key Finding 1: Methodological Contribution: Quantitatively measuring *Mathematical* Habitus using the Harris Dispositional Framework. This framework uses a valid and reliable measure of In-School Value, Out-School Value, Mathematical Relevance and Mathematical Confidence to produce a framework to use as a starting point in measuring *Mathematical Habitus.*

Key Finding 2: Methodological Contribution: Using the Harris Dispositional Framework to establish Key Predictors of each Mathematical Disposition. This outlines the analysis that used the framework to provide key predictors of pupils In-School Value, Out-School Value, Relevance and Confidence of mathematics.

Key Finding 3: Theoretical Contribution: The Key Predictors of a stronger *Mathematical Habitus.* This outlines the findings from regression and multivariate analysis which shows evidence of the operationalisation of Bourdieu's Theory of Practice to establish that gender, ethnicity, parents' attitudes and peer attitudes towards mathematics are key factors that impact *Mathematical Habitus*, which equals the impact on mathematical practices.

Key Finding 4: Why the attainment gap still exists. This finding outlines the issue of the use of bivariate analysis and the grade 4 pass threshold which is used in league tables to compare attainment levels. By using these methods of analysis and measures, research has suggested that attainment gaps still exist between particular groups such as gender and those eligible for free school meals. This research argues that these findings are inaccurate due the inappropriate methods of analysis used that does not take other factors into account, and do not reflect learners' everyday experiences.

Key Finding 5: The value and relevance of the mathematics curriculum. This finding outlines how pupils' perceptions on the value and relevance of the mathematics curriculum impacts pupils' *Mathematical Habitus* that equals impact on mathematical practices and educational outcomes.

Key Finding 6: The need to scale up this study. This research highlights the need for further study to understand how social and cultural factors impacts pupils' dispositions towards mathematics equalling impact on their mathematical practices and educational outcomes.

Key Finding 1: Methodological Contribution: Quantitatively measuring *Mathematical Habitus* using the Harris Dispositional Framework.

This section answers research question 1 'Can we quantitatively measure *habitus*?'. The aim was to assess the validity and reliability of the use of a multi-item scale to construct a valid and reliable measure of *habitus* through a series of factor analysis and structural equation modelling, to produce the Harris Dispositional Framework. This section will outline the steps taken to produce the measure of *Mathematical Habitus* using multivariate regression and multilevel modelling. The Harris Dispositional Framework serves as an integral part of the construct of *Mathematical Habitus* due to the understanding that *habitus* is a set of dispositions (Bourdieu, 1977), with *Mathematical Habitus* being a set of dispositions towards mathematics (Kennedy, 2012), which this framework considers by containing four key dispositions: In-School value, Out-School value, relevance and confidence. This framework is intended to be used to measure how an individual's place in the social system and roots in family upbringing (Bourdieu, 1977) influences these dispositions, called *Mathematical Habitus*. This is due to the understanding that *habitus* and capital are relational to one another that cannot be measured independently of one another (Bourdieu, 1977). The use of structural equation modelling is used to inform the reliability of the measure that the four dispositions are a valid construct to measure *Mathematical Habitus*, with multivariate regression and multi-level modelling analysis informing the use of the framework as a starting point to measure *Mathematical Habitus.* This does not go without the acknowledgement that any attempt at describing and explaining the world must be fallible, and open to critique and replacement by a different set of categories and relationships (Scott, 2005).

The wealth of literature amongst using Bourdieu's concepts within educational research lies heavily within the qualitative field (Ingram 2009, 2018; Reay 2017, 2019) with little regard to how it lends itself to the quantitative field, and lack of acknowledgement of Bourdieu's use of quantitative methods throughout his work. Particular attention must be paid to Bourdieu's preface in *Reproduction in Education, Society and Culture* (1990) where he publicises his frustration of his work being incorrectly interpretated, and translations of his work not including the empirical evidence which his research is based upon. Here, particular attention is given to Bourdieu's (1990) model of 'educational career and its system of determinations model' that attempts to capture how *habitus* is affected by demographics, social and cultural capital, and the environment. This indicates the reflexive nature of *habitus* and its opportunity to produce different educational outcomes for pupils depending on the demographics and social and cultural capital they have access to. This model provides the inspiration for the quantitative analysis outlined in this research.

Drawing on Bourdieu's theoretical concepts of *habitus*, capital and field, it must be acknowledged that these concepts are complex and cannot be deducted to one definition, nor can they be used independently of one another. Instead, they intertwine and work together to influence practice which is demonstrated in Bourdieu's formula '(*Habitus* x capital) + field = practice' Bourdieu (1977:101). Furthermore, the epistemological underpinning of this work lends itself to critical realism that understands that society is complex and messy where knowledge must always be fallible and open to critique and replacement by a different set of categories and relationships (Sayer, 2000; Scott, 2005), that supports this researching being the starting point of measuring *Mathematical Habitus*. This lends itself to applying Bourdieu's concepts, which are always in a state of transition through development by educational researchers as society and the education system progresses. His concepts are used as tools rather than definitions that allow for the exploration of educational inequalities to exist (Savage *et al*, 2013; Ingram and Abrahams, 2016; Friedman *et al* 2015; Reay, 2017). For example, Ingram and Abrahams (2016) use Bourdieu's concept of *habitus* as a tool to develop four typologies to explore changes in the *habitus*. This highlights the recognition of working with Bourdieu's concepts and the opportunity for change and development within and through his concepts.

Creation of the measure

With the epistemological underpinnings in mind, the development of the measure of the Harris Dispositional Framework to be used to measure *Mathematical Habitus* required the creation of a survey. Due to reports from TIMSS and PISA indicating that UK pupils were outperformed by Singapore and China amongst their mathematical attainment levels, this sparked the development of the Teacher Exchange Programme in 2016 to enhance mathematical attainment in England, and brought the introduction of mastery into the UK mathematics curriculum. This was based on the idea that implementing the mastery method of teaching, which is used by Singapore and China, will enhance the mathematical ability of pupils in the UK. As TIMSS and PISA survey Year 9 pupils to gather these findings, Year 9 pupils were sampled for this research as it aligned with the current trends in data. The design of the survey incorporated questions using Likert and scale measures with the analysis process in mind. Likert and scale measures allow for reliability and validity testing and for appropriate multivariate analysis to be carried out. The survey focused on four main concepts, pupils: In-School value, Out-School value, relevance and confidence of mathematics that measure pupils' dispositions towards mathematics across all six topics of the national curriculum: number, algebra, rates, ratio and proportion, geometry, statistics and probability.

The concept of value is gaining traction from government for being an issue (DfE, 2023), with this research differentiating between In-School value: mathematics being valuable within the school setting, and Out-School value: mathematics being valuable outside the school setting. Research by Vinner (1997, 2000) highlights that GCSE mathematics can be compared to money as it is used as credit to gain access to further education and careers, where the GCSE mathematics qualification holds exchange value within and beyond the education system. However, the actual skills pupils learn within mathematics are not useful as schools are teaching for the test, with majority of pupils aged 14-16 years identifying that the mathematics they are taught is only useful in the classroom (Onion, 2004; ACME, 2011). Whether pupils could distinguish between In-School and Out-School value were important to measure to understand how these dispositions impacted *Mathematical Habitus*. Therefore, the following statements were asked of pupils using a simple yes or no answer box to encourage pupils to be honest and give their perception, where a total score was calculated for each disposition.

Table 75: Overview of statements used to measure In-School and Out-School Value

In-School value	Learning (number/algebra/ ratio, proportion and change/ probability/ statistics/ geometry) will help me to pass my exam.
Out-School value	Learning (number/algebra/ ratio, proportion and change/ probability/ statistics/ geometry) will give me more career opportunities.

The concept of relevance was central to this research, as existing studies indicate that many pupils struggle to perceive mathematics to be relevant to their current or future lives beyond the classroom. This disconnect is further echoed by employers, who often argue that school mathematics does not adequately prepare pupils for the demands of the workplace (Hernandez-Martinez and Vos, 2018; Onion, 2004; Hall *et al*, 1999). The researchers experience teaching secondary mathematics also impacted the development of this measure where ‘where am I going to use this?’ was a weekly occurrence amongst the student body, therefore the impact of pupils’ disposition towards the relevance of mathematics was important to identify. The following statement was developed with the same yes or no style answer box when asked about their disposition towards in school and Out-School value.

Table 76: Overview of statement used to measure Relevance

Relevance	I will use (number/algebra/ ratio, proportion and change/ probability/ statistics/ geometry) in my everyday life.

Confidence is the final concept that is used in the Harris Dispositional Framework. Confidence is important as it refers to the pupil's belief in their mathematical ability, and is one of the most influential factors affecting mathematical achievement (Stankov *et al*, 2014; Kunhertani and Santosa, 2018). The measurement of confidence differed slightly to include a scale measure (1 – not at all confident, 5 – very confident) where pupils were asked how confident they were completing two different tasks taken from each topic of the national mathematics curriculum. The following statement was developed:

Table 77: Overview of statement used to measure Confidence

Confidence	On a scale of 1-5, how confident do you feel with the topics below

Reliability of the measures

Once data collection was completed, factor analysis was conducted to ensure the validity of each measure. Holmes Finch (2020) identifies the importance of having strong theory to underpin the successful use of factor analysis, therefore as Bourdieu (1977) refers to *habitus* as being a set of dispositions and the importance of understanding what we think and feel, that guides behaviour, there is sufficient literature and theoretical underpinning for factor analysis to be conducted to ensure that In-School value, Out-School value and relevance were valid constructs of *Mathematical Habitus,* that were three separate constructs. The factor analysis provided evidence that three different constructs were being measured, with all similar statements in the same factor. For example, all statements measuring In-School value were in factor 1, all statements measuring Out-School value were in factor 2, and all statements measuring relevance were in factor 3. As confidence was already a scale variable, validity testing was used that also provided evidence that confidence was a valid construct. Reliability testing was also considered on all four measures by the use of Cronbach's Alpha testing. The evidence presented that all four constructs were reliable and valid measures.

Structural Equation Modelling

Next, structural equation modelling was used to identify whether these four constructs lend themselves to an overarching latent construct: *Mathematical Habitus*. Literature suggests that *habitus* is made from a set of dispositions (Bourdieu, 1977; Kennedy, 2012), therefore structural equation modelling was used as it allows for the exploration whether all four dispositions contribute to the measurement of *Mathematical Habitus*. Structural equation modelling indicated a good model fit and provided evidence to suggest that In-School value, Out-School value, relevance and confidence are part of an overarching latent construct: *Mathematical Habitus*, therefore supports the use of the Harris Dispositional Framework as a starting point to measure *Mathematical Habitus.*

Although the model demonstrated a good model fit, it is important to recognise that, given the complexity of social science data, there is always scope for refinement and improvement. *Habitus* can also not be measured independently, so to fully capture Mathematical Habitus we must also consider the socio- cultural, demographic and structural factors (Bourdieu, 1977; Bourdieu and Passeron, 1990), especially when considering Bourdieu's (1990) careers and its system of determinations model to include the broader system of structures that shape individual dispositions. This model should therefore be viewed as an initial framework, a starting point for further exploration, rather than a definitive representation.

Together with the design of the survey, factor analysis, reliability and validity testing, and structural equation modelling, this provides evidence of the measurement of *Mathematical Habitus* using the Harris Dispositional Framework. However, to fully measure the impact of *habitus* on mathematical practice, taking inspiration from Bourdieu's (1977:101) equation '(*habitus* x capital) + field = practice' and his model of educational career and its system of determinations (1990), the impact of demographics, social, cultural capital and school and classroom must be used. This research provides a framework to use as a starting point to measure *Mathematical Habitus*, which to fully capture the impact on mathematical practice, I put forward the following formulae:

[**Mathematical Habitus** (Demographics x parents x peers) x **Capital**] + **Field** [(school x teacher) + education system] = **Mathematical Practice**

Here, *Mathematical Habitus* includes the interplay of social and cultural capital, alongside demographics, parents, peers, the school and teacher on pupils' dispositions towards mathematics, using the Harris Dispositional Framework, taking inspiration from Bourdieu's (1977) theory of practice and Edgerton *et al* (2012) equals mathematical practice.

Importantly, this section provides evidence of the use of the Harris Dispositional Framework that is not limited to mathematics; it is highly adaptable and can be tailored to any subject area by using national curriculum guidelines. Using this framework as a guide allows for groups to be identified as having lower subject-specific *habitus*, where interventions could be developed, and educators can design longitudinal studies to track changes in dispositions and practices over time. This is further supported by Navarro (2006) that identifies the concept of *habitus* being a social process leading to patterns that are transferable from one context to another.

Key Finding 2: Using the Harris Dispositional Framework to establish key predictors of each Mathematical disposition.

This section answers research question 2 'What factors affect pupils In-School value, Out-School value, relevance and confidence of mathematics?'. This section outlines the steps taken to explore key trends in the data that included a series of bivariate and multivariate analysis methods to fully capture the reliability of findings, and use of the Harris Dispositional Framework.

An inductive approach to data analysis was taken to fully explore the options of analysis available using the framework, and by taking findings from the structural equation model that In-School Value, Out-School Value, Relevance and Confidence impact *Mathematical Habitus* differently, as an increase of 1 of In-School Value increased *Mathematical Habitus* by .32, an increase of 1 in Out-School Value increased *Mathematical Habitus* by .55, and an increase of 1 of Relevance increase *Mathematical Habitus* by .43. Therefore, it was important to explore this and how different factors may influence each disposition.

Firstly, a series of bivariate analysis tests were conducted to allow for the exploration of trends in the data and for relationships between independent variables and each four of the latent constructs to be identified. All independent variables that passed parametric assumptions later contributed to a series of regression models that were used to identify the key predictors of each mathematical disposition. This yielded inconsistent results between the bivariate and multivariate analysis, as they produced different key predictors on each dependent variable. This supports the unreliability of previous research which has identified attainment gaps (The Sutton Trust, 2016, 2024; DfE, 2021). Due to the theoretical and methodological underpinnings of this research, and the understanding that *habitus* is complex, multivariate analysis is the most appropriate method as it allows for the exploration of multiple factors on the dependent variable, which reflects learners everyday experiences where pupils' are constantly impacted by factors such as their gender, ethnicity and free school meal eligibility at any one time. Furthermore, the sample size of this study also allows for regression modelling to be used, indicated through the passing of parametric assumptions.

Four regression models were conducted to capture the key predictors of In-School value, Out-School value, relevance and confidence of mathematics amongst Year 9 pupils in North West England. The decision was made to use all variables despite whether they were significant or not in bivariate, as long as they passed parametric assumptions, due to the acknowledgement that regression analysis is useful for predicting the impact of multiple variables which can cause differing results to bivariate analysis (Morrison *et al*, 2012; Saxena and Gupta, 2022). Furthermore, the epistemological underpinnings of critical realism understand how society is complex and messy (Sayer, 2000), with regression analysis allowing for the complexity to be measured which emphasises the need to use regression analysis. All four regression models contribute to the need to look at these dispositions separately to understand the process of measuring *Mathematical Habitus*, but to also evidence the impact of the social world and pupils' individual experiences on their behaviour, way of thinking, feeling and acting (Navarro, 2006). The findings from the individual regression models can also be used for targeted interventions for those groups that are identified as key predictors of each mathematical disposition, and supports the identification of the malleability of *habitus;* how the impact of demographic, social and cultural factors can change depending on whether we look at each mathematical disposition independently or *Mathematical Habitus* as a whole. This research suggests that by identifying the key predictors of each disposition, by improving one disposition will increase the *Mathematical Habitus* overall as, *habitus* is the outcome of a set of dispositions that contribute to the overall *Mathematical Habitus* score.

In-School value refers to the pupil's belief that the maths they learn at school is useful to pass their GCSE exam. Evidence from the regression model indicates an insufficient model fit when containing gender, speaking English as an additional language, free school meal eligibility, ethnicity, teacher gender, parent attitudes towards mathematics and peer attitudes towards mathematics. This suggests that when controlling for all other variables in the model, none of these factors are key predictors of pupils In-School value of mathematics. These findings are inconsistent with the bivariate analysis, which indicates that those who speak English as an Additional Language and eligible for free school meals have a weaker disposition towards the In-School value of mathematics than their counterparts, and those that have peers with positive attitudes towards mathematics also have a stronger disposition towards the In-School value of mathematics. This indicates that by looking at these variables independently, it would suggest that these factors could have an impact on pupils In-School value of mathematics, however bivariate analysis is not appropriate as there is never a time where an individual is only impacted by one factor.

Therefore, using the regression analysis, evidence suggests that there may be factors that are not included in the model that has an impact on pupils In-School value of mathematics due to the insufficient model fit. Bourdieu (1984) recognises the interplay of structure and agency on educational outcomes which multi-level modelling analysis allows to explore by the opportunity to include the impact of the school and classroom on pupils' *Mathematical Habitus*. The impact of the structure of school on this research must be acknowledged. Pais (2013) identifies that everyone within school is aiming for the common goal, to pass, therefore the impact of the school and classroom needs to be considered as different schools, classrooms and teachers offer different experiences and opportunities to their pupils. There is also the argument that schools are teaching for the test (The Advisory Committee on Mathematics Education, 2011), and due to this pupils' can see the value of the content learnt to pass the exam, as that is what they are told each day in school and is the purpose of their learning.

Out-School Value refers to the use of a GCSE mathematics qualification to help open more career opportunities for the pupils. Evidence from the regression model suggests that when controlling for all other variables in the model, peer attitudes is a key predictor of a stronger disposition towards the Out-School value of mathematics. These findings are inconsistent with the bivariate analysis, which indicates that females, those from a white ethnic background and those with peers with negative attitudes towards mathematics, have a weaker disposition towards the Out-School value of mathematics compared with their counterparts. However as discussed above, the bivariate analysis is not appropriate as variables do not act independently in a pupil's everyday life, therefore findings from the regression model are used. This provides evidence to suggest that if pupils have a weaker disposition towards the Out-School value of mathematics, then an intervention could be developed to improve the attitudes towards mathematics amongst peer groups to improve pupils Out-School value of mathematics.

Relevance refers to the belief by pupils that they will use the mathematics they learn in school in everyday life. Evidence from the regression model suggests that when controlling for all other variables in the model, parents' attitudes towards mathematics is a key predictor of a stronger disposition towards the relevance of mathematics. These findings are inconsistent with the bivariate analysis, which indicates that females, those from a white ethnic background, those who speak English as an additional language, those who parents do not help them with their homework, those with parents from an ethnic background other than black, and those that have parents and peers with negative attitudes towards mathematics have a weaker disposition towards the relevance of mathematics, compared with their counterparts. However, the bivariate findings are not appropriate for this research, therefore findings from the regression model are used. This provides evidence to suggest those with parents with negative attitudes towards mathematics have a weaker disposition towards the relevance of mathematics, therefore an intervention could be developed to improve parental attitudes towards mathematics to increase pupils' mathematical relevance.

Confidence refers to pupils' belief in their ability to perform certain mathematical tasks outlined in the Key stage 3 curriculum for their year group. Evidence from the regression model suggests that when controlling for all other variables in the model, being male, South Asian and having peers with positive attitudes towards mathematics are key predictors of increased mathematical confidence. These findings are inconsistent with the bivariate analysis, which indicates that females, those from a white ethnic background, those who are eligible for free school meals, those who parents do not help them with their homework, those with parents from an ethnic background other than South Asian and have parents and peers with negative attitudes towards mathematics, have a weaker disposition towards their mathematical confidence compared with their counterparts. Similar to the above, the bivariate analysis presented here is not appropriate for this data as regression modelling can be presented, therefore findings from the regression model are used. This provides evidence to suggest that females, those from ethnic groups other than South Asian, and those with peer groups with negative attitudes towards mathematics negatively impact pupils' mathematical confidence, indicating that these factors equal poorer mathematical practices and educational outcomes than females (Bourdieu,1977; Edgerton *et al*, 2012).

Overall, by conducting bivariate analysis before conducting regression analysis allowed for the relationships between variables to be established, and the exploration of the inappropriateness of using bivariate analysis when researching the impacts on educational outcomes as variables that impact pupils are not independent of each other in real life. This emphasises the importance of regression analysis to produce more reliable results that incorporate multiple variables at one time. This research also provides evidence for the use of regression modelling on each of the four dependent variables as findings can be used for targeted interventions for students to improve the strength of their dispositions towards mathematics, that increases their overall *Mathematical Habitus* and practice.

Key Finding 3: Key Predictors of a stronger *Mathematical Habitus*.

This section uses the Harris Dispositional Framework to provide evidence that gender, ethnicity, parents attitudes and peer attitudes are key factors that impact *Mathematical Habitus*.

This section answers research question 3 ‘What are the key predictors of a stronger *Mathematical Habitus*?’ and presents the findings of the fifth regression model that measures the impact of demographics and social and cultural capital on *Mathematical Habitus*.

Evidence from the regression model suggests that being male, South Asian and having peers with positive attitudes towards mathematics are key predictors of a stronger *Mathematical Habitus,* that equal stronger mathematical practices (Bourdieu, 1977; Edgerton et al, 2012). Research suggests (Bourdieu, 1986; 1990; Ingram and Abrahams, 2016; Reay, 2017) the education system favours particular cultural and social capital that aligns with middle class values, therefore those that do not have the capital that aligns with education having decreased educational outcomes (Costa and Murphy, 2015). Bourdieu (1984) calls this ‘the rule of the game’ where those that have the knowledge and capital to navigate through the education system do so more easily than those without the knowledge and capital that leads to differences within educational success between pupils. This suggests that being male, from a South Asian background, and having peers with positive attitudes towards mathematics is capital which the education system favours, as a stronger *Mathematical Habitus* equals stronger mathematical practices, that are positively associated with academic outcomes that incorporates attainment outcomes (Edgerton *et al*, 2012).

Males have a stronger *Mathematical Habitus* than females that contradicts National Statistics that females outperform males in mathematical performance (Education Policy Institute, 2024; DfE, 2024a). A majority of this literature that suggests that females outperform males uses the mathematics pass threshold of level 4 or above. This measure does not truly reflect those who get the highest grades, as majority of further studies in mathematics or careers in STEM require higher mathematical grades, and it is within these spaces where there are more males than females (Paechter 2001, O’Rourke and Prendergast, 2021). This research does not identify whether this disparity is due to more males receiving the top grades in mathematics, or whether it is due to the traditions of mathematics being seen as a ‘male’ subject, which attracts more males than females to study and obtain STEM careers (Paechter 2001, O’Rourke and Prendergast, 2021). Noyes (2003) highlights that students’ confidence in mathematics plays a crucial role in their transition into further mathematics education and STEM careers. The findings of this thesis suggest that male students tend to report higher levels of confidence, which may partly explain gender disparities in participation. However, Noyes (2003) emphasises that confidence alone does not account for these differences. Societal narratives, curriculum design, and school culture also significantly influence students’ perceptions of mathematics and their decisions to pursue it further. Therefore, this is evidence to suggest further research is needed to distinguish gender differences in mathematics attainment levels and confidence, with the aim in strengthening female’s *Mathematical Habitus*.

Pupils from a South Asian ethnic background have a stronger *Mathematical Habitus* than any other ethnic group. This is supported by Modood’s (2004) ethnic capital. He argues that those from ethnic minority backgrounds have the ambition to use education for upward social mobility that is influenced by their parents and communities, and enhances pupils’ educational outcomes. Literature suggested that Chinese pupils consistently outperformed any other ethnic group in mathematics (DfE, 2024, Boylan *et al*, 2019), however due to the low sample size, the Chinese ethnic group were not included in any regression analysis. Furthermore, these findings do support that there are differences in *Mathematical Habitus* between ethnic groups, which is in line with evidence that the achievement gap now exists between white and minority ethnic groups with minority ethnic groups, due to them consistently outperforming those from a white background (Tikly *et al*, 2006). A plausible explanation for differences in *Mathematical Habitus* between ethnic groups is the differences in ethnic practices and norms between groups (Modood, 2004; Evans and Field, 2020), that can support or hinder educational success depending on whether they align with the norms and practices that are favoured by the education system. More research is needed to understand how cultural and educational norms and values align, or not, and how this impacts mathematical outcomes.

Those pupils that have peers with positive attitudes towards mathematics have a stronger *Mathematical Habitus* than those pupils with peers with negative attitudes towards mathematics, and is one of the key predictors of a stronger *Mathematical Habitus.* This is supported by The Coleman Report (1966) that identified that peers were the most significant determinant of pupils' attainment, as pupils decide whether to invest their time and effort into anything depending on the costs and benefits of their relationships with their peers (Sokatch, 2006). Peers become more influential to the individual as it is those who they share most of their time with, where they develop close relationships, and their peer opinions matter and impact individual opinions and expectations of their mathematical attainment (Molloy *et al*, 2011; Bakar, *et al* 2021; Ryan *et al*, 2019). Furthermore, it is during teenage years where peers are one of the most influential factors on pupils' attainment (Molloy *et al*, 2011; Baker *et al*, 2021), suggesting a reason why peers were significant across all of the four dispositions due to the sample being amongst those aged 13-14 years old. It is important to highlight here where peer attitudes intersect with age. Although regression is more appropriate than bivariate analysis, peer attitudes was the only variable that was significant across all four dependent variables which suggests the importance of peers on *Mathematical Habitus*. Therefore, more focus is needed into how peers impact pupils' educational outcomes.

These findings suggests that those who are male, South Asian and have peers with positive attitudes towards mathematics are key predictors of a stronger *Mathematical Habitus,* however it must be recognised that this is only appropriate for the sample of pupils in this study which is due to the sampling technique that is not representative of the whole UK population.

The final regression model that measures the key predictors of *Mathematical Habitus* provides evidence of the impact of demographic, social and cultural factors on *Mathematical Habitus*, which also provides evidence of the use of the Harris Dispositional Framework as a starting point to measure *Mathematical Habitus,* and to produce key predictors of a stronger *Mathematical Habitus*. When working with Bourdieu's concepts he emphasises the interplay of structure and agency on educational outcomes (Bourdieu, 1984). Therefore, multi-level modelling was attempted to incorporate the impact of the school attended, and classroom on pupil's *Mathematical Habitus*, However, due to an insufficient sample size multi- level modelling was not appropriate for this analysis.

This research provides evidence of the complexity of *Mathematical Habitus* and the need to look at how *habitus* impacts pupils' mathematical practices, that could be used as an indicator to explore differences between educational outcomes nationally and internationally. This also provides a rationale to move away from focusing on grades, and instead looking at cultural and social experiences of pupils that impact their practices instead. This highlights that education is not a fair playing field for all, and pupils do have differing experiences, depending on their demographics, social and cultural capital, teacher, classroom and school attended. These findings can help schools to implement targeted interventions for these groups to potentially increase their *Mathematical Habitus* and practices.

Key Finding 4: Why the attainment gap still exists.

This section discusses the issue of bivariate analysis to inform differences in educational outcomes, and the need for complex models to understand the factors that impact educational outcomes. This section suggests that free school meal eligibility does not have an effect on *Mathematical Habitus* when taking account for gender, ethnicity, speaking English as an additional language, parents and peers' attitudes, but does have an impact within the bivariate analysis on In-School value and confidence of mathematics. This section also discusses the problem of using bivariate analysis for GCSE mathematic statistics comparisons between gender.

When discussing factors that affect attainment levels, especially within mathematics, free school meal eligibility is one of the most discussed factors and is one of the main factors policy and schools aim to address (The Sutton Trust, 2017, 2024). However, the way the data is analysed to produce these findings is problematic as Sayer (2000) identifies that social science data is often a product of multiple components and forces where we cannot isolate the components and examine them individually. Additionally, the international league surveys (TIMSS and PISA) highlight poverty as being one of the most important factors affecting pupils' educational success (Richardson *et al*, 2019; Sizmur *et al*, 2019), indicating the prevalence of the attainment gap due to poverty throughout government research, and the over reliance on comparative and bivariate analysis techniques.

It is important to recognise how the data in these studies are being measured and how this may be problematic when drawing conclusions. During the bivariate analysis section of this research, it was identified that free school meal eligibility had an impact on In-School value and confidence, with those eligible for free school meals consistently underperforming when compared with those not eligible for free school meals. However, when free school meal eligibility was included in the regression model analysis that included other factors such as gender, ethnicity, speaking English as an additional language, teacher gender and parent and peer attitudes, free school meal eligibility was no longer significant. This suggests methodological implications of using bivariate analysis. The issue with bivariate analysis is that it only accounts for the two variables being assessed at any one time, that is independent of all other factors, where in the social world multiple factors are always influencing an individual at any one time such as individuals' demographic factors and experiences. Therefore, using findings from regression model analysis is more appropriate as it takes into account this complexity and multiple factors at any one time. However it must also be acknowledged that not all data allows for regression model analysis, therefore is not always possible. However, this research provides the need to strive for appropriate sample sizes, and regression or multi-level model analysis which provides a more accurate representation of the conditions of the social world, and provides more valid and reliable results.

The issue is most research uses bivariate analysis techniques to draw conclusions (The Sutton Trust, 2016; 2024; DfE, 2024), which according to the data outlined in this research, are inaccurate. This dominates the education space which guides school practices to ensure they provide extra support for those groups labelled as 'underperforming'. These extractions are not accurate when taking into account other factors that influence an individual's life simultaneously such as their demographics and social experiences. For example, The Sutton Trust (2016) have embedded targeted interventions over time for those socio-economically disadvantaged groups, where the attainment gap still exists today (DfE, 2024). By embedding interventions based on bivariate analysis findings, it does not take into account other factors of the individual that may be more influential than some others. As this research presents, when looking at free school meal eligibility alongside other factors such as gender, ethnicity, parent and peer attitudes, free school meal eligibility is not a key predictor of *Mathematical Habitus*, whereas gender is. Therefore, it would be more beneficial to focus on gender than it would free school meal eligibility as the regression model presents that free school meal eligibility is not significant. Instead, this research suggests that focus should be given to gender, ethnic groups and peer interventions and their impact on *Mathematical Habitus* for the population of this study. Furthermore, in the regression analysis, those eligible for free school meals increased the strength of pupil's *Mathematical Habitus*, that is contradictory to the bivariate analysis in this research, and previous literature, that suggests that those eligible for free school meals perform less well (Francis-Devine *et al*, 2024; Richardson *et al*, 2020; The Sutton Trust, 2024). As free school meal eligibility is used in this research as a proxy for socio-economic status due to the difficulties in measuring social class, and the use of free school meal eligibility throughout educational research as a proxy of social class (Savage *et al*, 2013; ONS, 2022), these findings are evidence towards moving away from the importance of class, particular due to the way data is analysed, and towards methods of analysis that incorporate multiple variables at any one time.

Furthermore, a similar issue arises when looking at gender differences and educational success. Research suggests that females outperform males in mathematics (Education Policy Institute, 2024), however the issue with this is the analysis and reporting of the data. National statistics use the pass rate (grade 4 or above) to compare groups, however there is a disparity between these pass rates and the gender of those that apply to study further mathematics (37.7%), and go into STEM related courses (26%) (McGee, 2024; Census, 2024). The reasons why this occurs are not evident, but there is speculation that STEM subjects are seen as male careers that do not appeal to women, but there has been a movement to support women getting into these careers (Paechter 2001, O'Rourke and Prendergast, 2021; McGee 2024). Furthermore, when looking at entry tariffs into these courses, to be qualified for a STEM career majority ask for a grade 6 or above which is higher than the national pass rate, therefore it is unclear whether these gender differences are due to the high mathematical grades needed for entry, or the stereotype of the subject.

In this research, it provided evidence that males have a stronger *Mathematical Habitus,* that also suggests due to *habitus* equalling practice (Bourdieu, 1977) that is positively associated with educational outcomes, (Edgerton *et al*, 2012), males would also outperform females at the higher level of the GCSE grading. Differences between males and females were consistent across three dependent variables (Out-School value, relevance and confidence): males consistently outperformed females. This provides evidence for the need to stop using the pass threshold of grade 4 and above in government statistics and research as it is not producing an accurate representation of gender differences in education, and supports the continuation of promoting getting girls into STEM subjects. However, grades may be a barrier for this, therefore more research needs to be conducted moving away from using the pass threshold as a comparison level of attainment levels.

Overall, humans are complex with many different characteristics and experiences which intercept each other and impacts our behaviour and outcomes. Regression analysis is appropriate in capturing this complexity with its ability to measure the impact of multiple variables on a dependent variable at any one time. Regression modelling captures how the dependent variable is externally influenced to address the real world which coincides with the epistemological aims of the study, to investigate how the interplay of capitals and *habitus* impacts *Mathematical Habitus.* Therefore, based on the evidence discussed, an argument can be made for the use of the Harris Dispositional Framework by schools and government to measure key predictors of *Mathematical Habitus*, where targeted interventions could be made to narrow attainment gaps, but also be used as a tool for future regression model analysis for any further research into educational inequalities, which are used to inform policy and interventions by schools.

Key Finding 5: The value and relevance of the mathematics curriculum.

This section discusses pupils' perceptions of the value and relevance of the mathematics curriculum and how this impacts *Mathematical Habitus*.

Although educational researchers, teachers and government have their views on the value and relevance of the mathematics curriculum, it is important to understand whether this same view is held by the pupils that study and are examined on that exact curriculum. This research found that of all six topics of the curriculum, algebra was the topic what pupils identified to be the least valuable and relevant to them. This research suggests that pupils' dispositions towards the value and relevance of mathematics impacts *Mathematical Habitus* that equals the impact on mathematical practices (Bourdieu, 1977; Edgerton *et al*, 2013). Therefore, as algebra holds the highest proportion of content in a GCSE exam, this suggests that algebra could be a barrier towards mathematical attainment levels for those that do not deem it valuable or relevant. Furthermore, when students undertake their mathematics GCSE, they are split into foundation and higher. Those who sit a foundation exam can only achieve a maximum of grade 5, whereas those who sit higher can get the maximum grade 9. These exams come with different weightings of the six mathematics topics, and although algebra is still the most weighted, on a foundation exam it is 10% lower than the higher paper (OCR, 2020), implying that algebra is seen as a more difficult concept due to the foundation paper focusing more on the basic mathematical concepts.

On average, pupils believe the mathematics curriculum has more value than relevance, with the average relevance score being lower amongst the year 9 pupils in this sample, compared to the In-School value score being the highest. This suggests that pupils believe the mathematical content they learn at school has more value to help them pass their exam than it does to open different career paths and provide skills that they will use in their everyday lives. When looking at the relevance of each individual mathematics topic, algebra had the lowest relevance amongst year 9 pupils as only 21.9% (n364) believed they would use algebra in their everyday lives. Research by Hernandez-Martinez and Vos (2018) and Onion (2004) suggests that mathematics is often described as an abstract concept with its usefulness often seen as a tool for thinking and problem solving, with pupils not being able to see the relevance of mathematics to their current or future lives outside of school. This is supported by the data as overall pupil's relevance of the mathematical curriculum was lower than its In-School and Out-School value. This supports Niss (1994) that argues that there is a lack of connection between pupils not finding mathematics relevant but knowing that they need it, which can cause tension within the *habitus*, and could be used as an explanation of different outcomes of *Mathematical Habitus* depending on the experiences of the individual.

Where the pupils do experience this conflict, this can cause a destabilized *habitus*. Although Ingram and Abrahams (2016) explain this to be where pupils try to navigate two different fields which are always felt to be in conflict where the individual does not fit in, this concept can apply when exploring the tension between the value and relevance of the mathematics curriculum where the individual does not see the relevance of mathematics, but understands the value of it. Here, the pupil is always in conflict with their perceptions and feelings where they feel like they don't fit in, and always feel like they cannot be successful in mathematics. Furthermore, Ingram and Abrahams (2016) also explain the reconciled *habitus* to be where pupils can navigate two different fields as they draw on different aspects of their *habitus* and requires more reflexivity. Again, this concept could be applied to the conflict pupils experience between the value and relevance of mathematics, but depending on an individual's social and cultural capital, they are able to navigate through the conflict more easily that can have different outcomes on their *Mathematical Habitus* and practices. This provides an explanation for the differences between individuals experiences of school and their *Mathematical Habitus,* and highlights the need for further study and data within this area.

Gravemeijer *et al* (2017) acknowledge the tension between the mathematics content taught in schools and the actual mathematical demands of society, particularly as more mathematical tasks are now performed by machines rather than people. This highlights the potential irrelevance of the current mathematics curriculum and points to the need for a comprehensive review to better prepare pupils with practical and meaningful skills for their futures (DfE, 2015).

Despite numerous past attempts to address this issue including suggestions from Tomlinson (2004), Voderman *et al* (2011) and Robinson (2022), and government recognition of the distinction between academic mathematics and everyday mathematics (DfE, 2012; 2021; 2024d), little meaningful or impactful change has been implemented. This research adds to these calls for reform, emphasising the potential benefits of a curriculum that prioritises 'everyday maths' to create a more inclusive educational experience. In this proposed model, pupils who excel and are mathematically fluent could opt for a more advanced, traditional pathway such as the current GCSE mathematics, rather than expecting all pupils that struggle to simply "keep practicing" to achieve the qualification. However, this would also require changes to school accountability measures, such as revising league tables to include functional skills mathematics rather than focusing solely on GCSE results.

Interestingly, findings from this study show that 53.9% (n888) of Year 9 pupils identified ‘number’ as the most relevant mathematical topic for everyday life, a concept aligned with ‘everyday mathematics’ (Nunes et al, 1993; Lave and Wenger, 1998). Proficiency in everyday mathematics does not always translate to high performance in school mathematics assessments, especially as numeracy is given a lower weighting in GCSE exams. This reveals a clear disconnect between what is taught and what pupils perceive as valuable and practical for their lives.

Meece *et al* (2006) suggest that when pupils perceive content as relevant and valuable, they are more likely to engage, positively affecting their mathematical practices, *habitus*, and performance. Thus, this research highlights the importance of considering pupils’ views on the value and relevance of mathematics. It highlights the need to shift focus from solely targeting pupils' abilities and teaching methods, to critically examining and redesigning the mathematics curriculum itself.

Key Finding 6: The need to scale up this study.

This section outlines the need for further study on a national scale to identify the key predictors of *Mathematical Habitus,* and the research needed to focus on the influence of peers.

To fully understand the impact of *habitus* on mathematical practices, Bourdieu emphasised the need to include structure and agency (Bourdieu, 1984, 1990). This research has attempted to understand how schools, teachers and classrooms also impact *Mathematical Habitus*, however there was not an appropriate sample size to yield any results. Research by Reay (2017), Voderman *et al* (2011) and Hussain (2016) suggests that the school a pupil attends can impact their educational outcomes due to deprivation levels, admission levels and access to trained teachers, which highlights the importance for a larger scale study to identify how the school and classroom structure impacts *Mathematical Habitus.*

The first step of the multi-level model did not find statistical significance between school attended and *Mathematical Habitus*, however due to the sampling strategy of the research by using contacts and gatekeepers that had access to particular schools, all but 3 schools had a higher percentage of pupils eligible for free school meals than the national average (24.4%) (GOV, 2024). This could impact the significance of the results as schools were demographically similar. Therefore, research needs to be repeated with a wider range of schools from different areas. Furthermore, multi-level model analysis could not analyse the impact of schools and teachers when taking into account all other factors in the regression model due to an insufficient sample size. Therefore, post hoc power analysis (Donner, Birkett and Buck, 1991) was completed to understand the appropriate sample size to conduct the research. This found that 111 schools, 18,895 pupils and 169 teachers are needed to successfully conduct this research, using the multi-level model to understand the impact of the school and teacher alongside the cultural and social factors of the individual on *Mathematical Habitus*.

A national study would be beneficial as mathematics is still integral to gain access to further study and careers, therefore not achieving a level 4 or above in GCSE mathematics limits pupils' access to further study and careers, however what is important to consider is the content in the curriculum and the weightings of each topic that are tested in a GCSE exam paper. There are arguments that the content is not relevant to the future studies and careers pupils will go in to, and instead the GCSE mathematics qualification is used as credit to exchange for access into these spaces (Vinner 1997, 2000). This argument highlights the need to look at pupils' perceptions of the value and relevance of GCSE mathematics nationally to investigate how this may impact pupils' mathematics attainment and highlights the need of change within the curriculum to serve the pupils of today's society. The framework outlined in this study can be used to explore this further.

This research has unveiled the complexities of mathematical outcomes. Therefore, a national study would be useful to outline the key predictors of *Mathematical Habitus,* where the results could be used to develop interventions to support those students that ‘underperform’ in mathematics. As society becomes increasingly diverse, and with the potential for curriculum reform, as seen in the recent review in Wales (Gov.Wales, 2023), this framework offers valuable insights into how schools can better support groups identified within the key predictor categories. By focusing on pupils who hold weaker dispositions towards mathematics, schools can develop strategies to strengthen their engagement and confidence. Additionally, this framework provides researchers and policymakers with a deeper understanding of what pupil’s value, informing how the curriculum might be adapted to become more meaningful and relevant to today’s youth. Such changes have the potential to enhance mathematical attainment across England.

A key factor this research has uncovered is the importance of peers on *Mathematical Habitus.* Although these findings can only be generalised to the sample population, peers were significant throughout all bivariate and regression analysis. This provides evidence to suggest that peers could be more influential than any other factor, therefore further research is needed on the impact of peers on pupils’ educational outcomes. Further research into peers could also allow us to differentiate between different types of *habitus*, inspired by the work of Ingram and Abrahams (2016) and Willis (1977). This is due to the literature suggesting that depending on an individual’s background depends on whether or not their *habitus* changes, or whether the pupil disengages with education. Therefore, by using the Harris Dispositional Framework as a starting point, further research could be conducted into the impact of peers and *Mathematical Habitus* that may be able to uncover these challenges.

Overall, this research suggests that changes in *Mathematical Habitus* will equal a change in mathematical practices, therefore a longitudinal study to look at this impact world be beneficial. Furthermore, interventions could be implemented for pupils in those groups identified as key predictors and have a lower *Mathematical Habitus,* where their progress can be assessed over time, to see whether their *Mathematical Habitus* and practices increase. These longitudinal studies would also provide empirical evidence of Bourdieu’s (1977: 170) ‘(*habitus* x capital) + field = practice’.

> “*Habitus* is neither a result of free will, nor determined by structures, but created by a kind of interplay between the two over time: dispositions that are both shaped by past events and structures, and that shape current practices and structures and also, importantly, that condition our very perceptions of these” (Bourdieu 1984: 170).

This suggests the importance of monitoring *habitus* over time and the impact of the interplay of structure and agency. Therefore, a national study using multi-level modelling could provide robust empirical evidence of how strengthening pupils’ subject-related *habitus* contributes to improved practices and educational outcomes. Such an approach has the potential to inform more inclusive, relevant, and impactful interventions across the curriculum, ensuring that teaching not only transmits knowledge but also shapes positive educational outcomes.

Reflecting on the limitations and recommendations for the future

This research aimed to measure *Mathematical Habitus* and use of the measure to identify the key predictors of *Mathematical Habitus*. The aim was to understand what factors contribute to differentiation between mathematical practices by taking into account the pupils social and cultural context. Although this research provided evidence of a highly valid and reliable measure of *Mathematical Habitus*, there are some limitations that need to be addressed to allow for this study to be replicable.

Measuring ethnicity

Ethnicity was measured using the 17-point measure suggested by Governments Race Disparity Unit (2023), and due to the sample size and methodological reasoning to have the appropriate data for testing, this was reduced to 6 categories for analysis: White, South Asian, Black, Mixed, Chinese and Other. Inspiration was taken from the Race Disparity Unit to take differences in regions into account and to understand the variance within each category. Therefore, the ‘Asian’ measure, was changed to South Asian, and to differentiate between Chinese and other Asian groups, as previous focus has been on the outperformance of Chinese pupils compared with any other ethnic group (The Sutton Trust, 2016; Richardson *et al*, 2020; DfE, 2024), the decision was made to split these two groups to identify any differences. However, due to the small sample size the Chinese category could not be included in all analysis, but it is suggested with an appropriate sample size outlined in the post-hoc power analysis (Donner, Birkett and Buck, 1981) these differences could be measured.

Including guardians in research

It is acknowledged that not all pupils have parents, with the percentage of pupils with a guardian not recorded by national statistics. A guardian is a person that is responsible for a child that can be anyone from a family member, adopted family or caregiver. During data collection pupils were asked whether they have a parent and guardian, however due to the small sample size of the guardian category, 6.1% (n23), it was not appropriate for testing. A bigger sample could yield a more appropriate sample size to identify the impact of parents and guardians' attitudes towards mathematics on pupil's *Mathematical Habitus*, especially as Bourdieu (1977) argues that family are fundamental in influencing pupils' dispositions. This supports the importance to acknowledge how not living with biological family impacts *Mathematical Habitus*, but also an adaptation to the measure for the future.

Measuring language proficiency

Although measuring English as an additional language is important for understanding how language can influence mathematical performance, particularly given that the GCSE mathematics paper demands a high level of language proficiency (Fuchs *et al*, 2006), this measure alone does not fully capture a pupils language ability. The EAL indicator does not account for factors such as the length of time a student has been speaking English or their depth of comprehension and interpretation of the language (Strand *et al,* 2015). Furthermore, this has also unveiled the impact of language proficiency amongst those pupils who may have low reading ages or special educational needs. Therefore, for future research it is recommended that a language proficiency measure is used instead that will measure the level of reading comprehension that can include those that speak English as an additional language but those who also have special educational needs.

Chapter 7: Concluding Remarks

This research was designed to develop and measure the concept of *Mathematical Habitus*, a construct that captures the social and cultural influences shaping pupils' mathematical dispositions and practices. A key aim was to identify predictors of a stronger *Mathematical Habitus*, not only as a tool to understand what pupil factors support *Mathematical Habitus* and practices, but also to highlight which groups of pupils may require additional support due to the influence of their demographic background or a lack of social and cultural capital.

This work responds to growing concerns about the implementation of the mastery approach in mathematics education (Boylan *et al* 2017, 2019). While mastery focuses on uniform progression and regular assessment, it often fails to account for social and cultural inequalities in how mathematics is accessed and experienced (Boylan at al, 2019; Smith *et al*, 2004). In particular, it overlooks the need to make mathematics relevant to pupils' everyday lives and future aspirations, as well as the importance of developing confidence with numbers, a critical skill in both employment and daily decision making (Voderman *et al*, 2011; National Numeracy, 2024). A lack of mathematical confidence, often rooted in early negative experiences, is known to undermine career opportunities and, in many cases, is transferred across generations, with parental anxiety around mathematics impacting children's attitudes and achievement (National Numeracy, 2024; Evans and Field, 2020; Stankov *et al*, 2014).

This research makes three core contributions to the field of mathematics education: methodological, theoretical, and policy and practice.

Methodological contribution

The study offers a series of valid and reliable quantitative measures that assess pupils', peers and parents' attitudes towards mathematics, In-School and Out-of-School Value, Mathematical Relevance, Mathematical Confidence, the Harris Dispositional Framework, and *Mathematical Habitus* itself. These tools are designed for future use in exploring the complex relationship of demographics, social and cultural capital, and structures on dispositions, and practices. Although this research has focused on mathematics, this framework can be adapted to any subject to uncover the key predictors of the subject-specific *habitus*. The findings produced from this measure enable researchers to investigate how these factors shape pupils' dispositions and educational outcomes, that allows for more targeted support for pupils.

Theoretical contribution

This research identifies key factors that contribute to *Mathematical Habitus*. The findings show that gender, ethnicity, and the attitudes of parents and peers play significant roles. Pupils who are male, from South Asian ethnic backgrounds, and have parents and peers with positive mathematical attitudes tend to exhibit a stronger *Mathematical Habitus*. In contrast, female pupils, those from other ethnic backgrounds, and those surrounded by negative attitudes are more likely to develop a weaker *Mathematical Habitus*, which can hinder mathematical practices and outcomes.

Notably, when breaking down the components of the Harris Dispositional Framework, pupils' dispositions toward the Out-School Value of mathematics emerged as the strongest predictor of *Mathematical Habitus*. This highlights the importance of how pupils perceive mathematics beyond the classroom, and suggests that negative peer influences can significantly diminish their perception of its everyday and future relevance, ultimately weakening their *Mathematical Habitus* and practices.

Policy and practice contribution

This research challenges current educational policy trends that prioritise pedagogical reforms such as mastery without sufficiently considering the socio-cultural factors that shape mathematical learning. It emphasises the need for schools and policymakers to rethink both their data collection methods and the interventions they design in response to that data. By accounting for the demographic, social, and cultural realities of pupils' lives, educational strategies can be better tailored to support those who are most at risk of underachievement.

This research also highlights how pupils' perceptions of the value and relevance of the mathematics curriculum can significantly impact their educational outcomes, highlighting the need for careful consideration and reform. It reveals the government's consistent rejection of previous reforms aimed at supporting underachieving pupils and shows how this neglect can negatively affect pupils' adult lives and the wider economy.

This study acts as a pilot for future research and a prompt for deeper dialogue between schools, researchers, and policymakers about the broader factors that affect mathematical outcomes. It also serves as a call to move beyond narrow definitions of attainment and to develop more holistic indicators of mathematical outcomes, like *Mathematical Habitus*.

A framework for understanding mathematical practice

This research establishes a starting point to measure *Mathematical Habitus* as an indicator of pupils' mathematical practices and outcomes. Grounded in the Harris Dispositional Framework and supported by robust statistical techniques including regression and multilevel modelling, this study offers a replicable framework for future investigation. At the same time, it highlights the necessity for further refinement, expansion, and validation with a larger and more diverse sample.

By applying regression and multilevel modelling, the study accounts for demographic, social, and cultural factors within the field of mathematics education. Drawing on Bourdieu's (1977:101) formula '(*Habitus* x Capital) + Field = Practice', the study proposes the following conceptual model:

[***Mathematical Habitus*** (Demographics x parents x peers) x **Capital**] + **Field** [(school x teacher) + education system] = **Mathematical Practice**

This formulation provides a theoretical and statistical basis to explore how different forms of capital and structures interact to shape mathematical practices.

Next Steps

There are two key next steps that emerge from this research:

1. To investigate whether a stronger *Mathematical Habitus* directly contributes to increased mathematical practices and higher attainment levels.
2. To replicate the study with a larger and more diverse sample, allowing for the inclusion of additional school and teacher level variables that may influence pupils' *Mathematical Habitus.*

Final reflections

This thesis contributes a practical framework for understanding the complex, relational nature of mathematical learning. By introducing the construct of *Mathematical Habitus*, it shifts the conversation away from purely cognitive or instructional explanations of underachievement and toward a more holistic view that recognises the deep entanglement of social and cultural factors.

Ultimately, this research argues that until the social and cultural context of mathematics education is fully acknowledged and addressed, educational reforms, no matter how well intentioned, will continue to fall short for many learners. Understanding *Mathematical Habitus* is a first step towards designing more inclusive and socially responsive educational environments that support all pupils, especially those who have historically been marginalised within mathematics education.

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Appendices

Table of Contents

Appendix A: Ethics and Questionnaire

Consent Form

Manchester Metropolitan University

CONSENT FORM

Teaching to Compete

School Identification Number: 1

	Please tick your chosen answer	YES	NO
1.	I confirm that I have read the participant information sheet version...., date.........for the above study.	☐	☐
2	I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐	☐
3	I understand that I and my school's participation is voluntary and that I am free to withdraw the school at any time without giving any reason, without my legal rights being affected.	☐	☐
4	I agree for the school to participate in the project to the extent of the activities described to me in the above participant information sheet.	☐	☐
5	I agree to audio recording to take place on the school site for analysis. No audio clips will be published without my express consent (additional media release form).	☐	☐
6	I understand and agree that data collected during the project will be shared with Manchester Metropolitan University.	☐	☐
7	I understand and agree that participants words may be quoted anonymously in research outputs.	☐	☐
8	I wish to be informed of the outcomes of this research. I can be contacted at: ______________________________	☐	☐
9	I give permission for the researchers named in the participant information sheet to contact me in the future about this research or other research opportunities.	☐	☐
10	I give permission for a fully anonymised version of the data I provide to be deposited in an Open Access repository so that it can be used for future research and learning.	☐	☐

______________	______________	______________
Name of person giving consent on behalf of the school	Date	Signature

______________	______________	______________
Name of person taking consent	Date	Signature

40593, version 2 28/07/2022

School information sheet

Manchester Metropolitan University

Head of School Information Sheet

Title of PhD Research Project: Teaching to Compete: A comparative study of implementing the mastery method to increase GCSE mathematics attainment

Name PhD Research Student: Sophie Harris

Email: sophie.harris2@stu.mmu.ac.uk

Project Start and End Date: September 2022 – July 2023

This information sheet contains details regarding research with your school which requires the participation of your pupils, teachers and parents answering a questionnaire and with some participants taking part in interviews or focus groups regarding their attitudes towards mathematics and the GCSE mathematics curriculum.

Details of the Research
The aim of this research is to identify factors associated with attitudes towards mathematics aged 13-14 years old and the impact of this on mathematical attainment. The reason for this research is taking place is to identify reasons behind negative attitudes towards mathematics and current views of the mathematics curriculum which previous research has found can be associated with low mathematics attainment. This research aims to specifically look at Year 9 pupils, their parents and teachers of mathematics.

Taking part in this research means that your pupils, mathematics teachers and parents will simply answer a questionnaire that will be kept confidential. Once the questionnaire has been completed, there will be follow up interviews with a small number of pupils, teachers and parents to explain their answers further. These will be audio recorded

By taking part in the questionnaire and interviews, your pupils, teachers and parents will help a research project that aims to discover what factors contribute to negative attitudes towards mathematics and views of the current mathematics curriculum. This research can then be used to inform any interventions that could be implemented to help increase mathematical attainment.

How your school can benefit from taking part
Your school will have the opportunity to choose either a university style workshop or extra maths tuition for pupils. I am a qualified Secondary Mathematics teacher comfortable teaching at this age group. In exchange for your pupils and teachers time, I will visit at a time that is most convenient for your pupils with a quantitative sociology university style workshop that is designed to give pupils an insight into what university style teaching is like and an opportunity to ask any questions about university. Alternatively, I can offer 2 x 1 hour sessions of extra maths tuition with small groups of pupils that may need extra

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support, again at a time most convenient for the pupils. Your school will also receive a report containing an analysis of the results of the questionnaires and interviews answered by pupils, teachers, and parents at your school, and for the whole study.

What is required of you, as Head Teacher?
I have prepared an information sheet for parents to read and complete. I ask that you notify the parents with a minimum of 2 week before my visit via information sheets, which I will provide. These forms would need to be distributed, subject to your consent, to parents using school-based communication platforms. Parents will have the right to withdraw their children, and themselves if they choose to take part in the research, at any time.

What is required of your pupils?
Your pupils would be asked to complete a questionnaire by the researcher. The questionnaire has been designed to be easily completed by pupils aged 13-14 years old so they can freely do it without any assistance. Pupils will be provided with an information sheet that clearly states that your pupil's participation is strictly voluntary and they do not have to answer the questions if they don't want to. They will also be informed that the questionnaire is confidential. Some pupils will also be invited to a focus group or individual interview at a time that's most appropriate for the school and pupil.

How long will it take?
The questionnaire should take approximately 10 minutes.

The interviews should take a maximum of 30 minutes per group of students/ individual pupil or per teacher.

The workshop will take approximately 1 hour which will include time for pupils and teachers to complete the questionnaire.

What is required of your teachers?
I will distribute the questionnaires to pupils with minimal assistance from teaching staff. As this will take place in a classroom, teachers and assistants would be asked to help distribute the questionnaires to the pupils and fill in their own questionnaire during the session. Teachers should in no way supervise students answering the questionnaire, even if it is to help them. If there is concern regarding a student answering the questionnaire due to a learning difference, then the child should not be asked to complete the questionnaire.

Approximately 3 mathematics teachers will be asked to take part in an interview that will last a maximum of 30 minutes about their experience of teaching mathematics and the GCSE curriculum. Teachers have the right to refuse or withdraw their participation from the research.

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How will I keep your teachers' information secure?
As the anonymity of your school is of upmost importance, all details regarding who participates in the questionnaire will be kept confidential. However, a copy of the questionnaire has been provided to fully disclose the nature of the research.

How will I keep your schools information secure?
The identity of your school will remain strictly confidential at all times. The only detail to be disclosed of any participating school in this research is that the school in located in Northwest England. I will provide my DBS on the day of my visit and prior to any data collection starting.

Paper questionnaires will be transferred from paper to a dataset stored on an encrypted digital drive. I will be the only handler of the data and will destroy physical copies of questionnaires once the transfer is complete. Transfer and destroying of physical data can take place on school premises if the head prefers.

What if you don't want your school to take part?
Allowing me to ask your Year 9 pupils and mathematics teachers to take part in the research is strictly your choice. You have the right to withdraw your consent at any time. Your pupils, teachers and parents also have the right to withdraw from the research 2 weeks prior to data collection and details will be provided via their information sheet. I have provided all 3 questionnaires in order to provide full disclosure.

Data Protection Law
Data protection legislation requires that we state the 'legal basis' for processing information about you. In the case of research, this is 'a task in the public interest.' If we use more sensitive information about you, such as information about your health, religion, or ethnicity (called 'special category' information), our basis lies in research in the public interest. Manchester Metropolitan is the Controller for this information and is responsible for looking after your data and using it in line with the requirements of the data protection legislation applicable in the UK.

You have the right to make choices about your information under the data protection legislation, such as the right of access and the right to object, although in some circumstances these rights are not absolute. If you have any questions, or would like to exercise these rights, please contact the researcher or the University Data Protection Officer using the details below.

You can stop being a part of the study at any time, without giving a reason. You can ask us to delete your data at any time, but it might not always be possible. If you ask us to delete information before July 2024, we will make sure this is done. If you ask us to delete data after this point, we might not be able to. If your data is anonymised, we will not be able to withdraw it, because we will not know which data is yours.

Manchester Metropolitan University

What will happen to the results of the research study?
A report outlining the findings of this research will be available and sent to your school once the research has been completed.

Who has reviewed this research project?
Manchester Metropolitan University Ethics and Governance Team.

Who do I contact if I have concerns about this study or I wish to complain?
Principal Researcher
Sophie Harris, sophie.harris2@stu.mmu.ac.uk

Principal Supervisor
Professor John Goldring, j.goldring@mmu.ac.uk, Tel: 0161 247 3441

Faculty Head of Research Ethics and Governance
Professor Sue Baines, s.baines@mmu.ac.uk, Tel 0161 247 2511

Manchester Metropolitan Data Protection Officer dataprotection@mmu.ac.uk
Tel: 0161 247 3331 Legal Services, All Saints Building, Manchester Metropolitan University, Manchester, M15 6BH

UK Information Commissioner's Office
You have the right to complain directly to the Information Commissioner's Office if you would like to complain about how we process your personal data:
https://ico.org.uk/global/contact-us/

Further information
Please contact me via the details provided if you require any additional information before agreeing to take part in the study.

THANK YOU FOR CONSIDERING PARTICIPATING IN THIS PROJECT

Parent information sheet

Parent/ Guardian Information Sheet

Title of PhD Research Project: Teaching to Compete: A comparative study of implementing the mastery method to increase GCSE mathematics attainment

Name PhD Research Student: Sophie Harris

Email: sophie.harris2@stu.mmu.ac.uk

Project Start and End Date: September 2022 – July 2023

I'm Sophie, a qualified maths teacher researching pupils attitudes towards maths. This information sheet contains details regarding research in your child's school, which requires their participation in answering a questionnaire regarding their attitudes towards maths. A select few pupils will also be invited to take part in a focus group or interview. This information sheet contains information about how you can also be involved in this research.

Details of the Research

The aim of this research is to identify factors associated with attitudes towards mathematics aged 13-14 years old and the impact of this on mathematical attainment. The reason for this research is taking place is to identify reasons behind negative attitudes towards mathematics and current views of the mathematics curriculum which previous research has found can be associated with low mathematics attainment. This research aims to specifically look at Year 9 pupils, their parents, and teachers of mathematics.

Another aim of this research is to identify parents' attitudes towards mathematics and their views of the current mathematics curriculum. Therefore, I am inviting you to fill out the questionnaire attached to this information sheet that will be kept confidential.

By taking part in the questionnaire and optional interview, your participation will help this PhD research to discover what parents think about GCSE mathematics and to give recommendations for change based off what parents would like to see change.

What are the benefits of taking part in this research?

By taking part in this research, you will be entered into a prize draw to win a £50 Amazon gift voucher.

What is required of your child?

Your child will be asked to complete a questionnaire by the researcher. With the questionnaire, there will be an information sheet fully disclosing information regarding the project. The information sheet will also clearly state that your child's participation is voluntary and they do not need to answer any questions they do not need to. They will also be informed that the questionnaire is confidential.

If you opt in to take part in an interview, your child will also be asked to take part in an interview to look at generational attitudes towards mathematics.

What is required of you, as a Parent?

If you are happy to take part in this research, then please complete the questionnaire provided by ticking the answers that represent how you wish to respond to each question. Before doing so, please ensure you have read all the information provided, including your right to refuse to take part. Once completed, please send back to the school.

How long will it take?

The questionnaire should take approximately 5 minutes

If invited for an interview, this should take no longer than 30 minutes.

How will I keep your child's/ your information secure?

The information provided by your child on the questionnaire and interview (if selected), will be safeguarded in compliance with the Data Protection Act 1998 and GDPR. Details will not be shared, as anonymity is of upmost importance to this research. All questionnaires will be inputted into an Excel file and audio recordings will be transcribed and stored on an encrypted hard drive. Once answers are securely stored, the paper copies will be physically destroyed, and audio recording will be deleted.

How do you withdraw your child/ yourself?

It is very important that you understand you have the right to withdraw your child and yourself from this research if you wish, any time prior to the research taking place as this research is anonymous. Your child also had the right to withdraw within the same time frame and will be made aware of this before completing the questionnaire.

You can exercise the right to withdraw your child and yourself at any time before the research takes place, by telling the school prior to my visit or contacting me via the details provided. I have requested that you are notified at least two weeks before my visit. The date arranged to visit your school is ________ .Please ensure if you do not wish for your child to take part, that you inform the school directly. By exercising your right to withdraw your child, the Year 9 lead and child's teacher will ensure that your child is not provided with a questionnaire to answer.

Data Protection Law

Data protection legislation requires that we state the 'legal basis' for processing information about you. In the case of research, this is 'a task in the public interest.' If we use more sensitive information about you, such as information about your health, religion, or ethnicity (called 'special category' information), our basis lies in research in the public interest. Manchester Metropolitan is the Controller for this information and is responsible for looking after your data and using it in line with the requirements of the data protection legislation applicable in the UK.

You have the right to make choices about your information under the data protection legislation, such as the right of access and the right to object, although in some circumstances these rights are not absolute. If you have any questions, or would like to exercise these rights, please contact the researcher or the University Data Protection Officer using the details below.

You can stop being a part of the study at any time, without giving a reason. You can ask us to delete your data at any time, but it might not always be possible. If you ask us to delete information before July 2024, we will make sure this is done. If you ask us to delete data after this point, we might not be able to. If your data is anonymised, we will not be able to withdraw it, because we will not know which data is yours.

What will happen to the results of the research study?

A report outlining the findings of this research will be available and sent to your childs school once the research has been completed.

Who has reviewed this research project?

Manchester Metropolitan University Ethics and Governance Team.

Who do I contact if I have concerns about this study or I wish to complain?

Principal Researcher
Sophie Harris, sophie.harris2@stu.mmu.ac.uk

Principal Supervisor
Professor John Goldring, j.goldring@mmu.ac.uk, Tel: 0161 247 3441

Faculty Head of Research Ethics and Governance
Professor Sue Baines, s.baines@mmu.ac.uk, Tel 0161 247 2511

Manchester Metropolitan Data Protection Officer dataprotection@mmu.ac.uk
Tel: 0161 247 3331 Legal Services, All Saints Building, Manchester Metropolitan University, Manchester, M15 6BH

UK Information Commissioner's Office
You have the right to complain directly to the Information Commissioner's Office if you would like to complain about how we process your personal data:
https://ico.org.uk/global/contact-us/

Further information

Please do not hesitate to contact me by email if you would like any more information regarding this research project. My email can be found at the beginning of this information sheet.

Pupil information sheet

Researcher Helper Booklet

Name:

Maths Teachers Name:

Maths set:

Manchester Metropolitan University

Pupil Information Sheet

Title of PhD Research Project: Teaching to Compete: A comparative study of implementing the mastery method to increase GCSE mathematics attainment

Name PhD Research Student: Sophie Harris

Email: sophie.harris2@stu.mmu.ac.uk

Who am I?
Hello, my name is Sophie and I would like to ask you some questions about maths. I want to do this because I am interested in what young adults think about maths. This is part of a project I am doing at university, and I would like you to take part.

If you don't want to complete this, you don't have to. You don't have to do anything with the questionnaire, and I will collect it from you.

If you would like to take part in my project, you can answer the questions once you have read this and understand everything. If you are not sure you can ask me any questions you would like about it.

If you do answer the questionnaire, it is very important that once you finish you put it face down on your desk for it to be collected. Make sure to answer the questions as honest as possible. Your responses to this questionnaire will not be shared with anyone and it is important to get your honest opinion for this research. There are no right or wrong answers and it does not matter if you like or dislike maths. I just need you to be as honest as you can be so that I can better understand your views on learning maths whilst at school.

What is this research?
I am doing this research to try to understand pupils attitudes towards mathematics and how it affects pupils grades. The findings from this research will be used to inform schools and government what could be changed to the mathematics curriculum and what could be done to help pupils to improve their grades. Your information will be kept confidential, so no one will know who has completed the questionnaire or interviews.

How long will it take?
It will take about 10 minutes to complete

If you need help…
If you do not understand this information, then I will help explain it for you.

If you do not want to answer the questions, leave the pages blank and I will collect it later.

Data Protection Law
The way we look after your information is ruled by UK law. Under UK law, we need to have a very good reason for using your information (this is called a 'lawful basis'). Sometimes, we might also want to use sensitive information about you, like information about your health,

religion and ethnic background. This is called 'special category information'. We collect all this information from you to help with our research, which aims to benefit everyone (this means that it is in the 'public interest').

You have the right to make choices about your information under UK law. If you have any questions or would like to ask us to do something with your information, you can ask the researcher or a parent or guardian, or someone else at the University. Contact details are shown towards the bottom of this document.

You can stop being a part of the study at any time, without giving a reason. You can ask us to delete your data at any time, but it might not always be possible. If you ask us to delete information July 2024, we will make sure this is done. If you ask us to delete data after this point, we might not be able to. If your data is anonymised (where we take out your name and any other information that lets us know the information is about you), we will not be able to delete it, because we will not know which data is yours.

Thank you!

Pupil questionnaire

1. What is your gender?

Male ☐ Female ☐ Other ☐

2. What is your ethnicity?

White	British	
	Irish	
	Other white background	
Asian or Asian British	Indian	
	Pakistani	
	Bangladeshi	
	Any other Asian background	
Chinese	British Chinese	
	Chinese	
Black or Black British	African	
	Caribbean	
	Any other black background	
Mixed	White and Asian	
	White and Black	
	White and Chinese	
	White and any other	

3. Do you speak English as an additional language?

Yes ☐ No ☐

4. Do you have free school meals?

Yes ☐ No ☐

5. Do you have extra maths tuition outside of school?

Yes ☐ No ☐

6. Do your parents help you with your maths homework?

Yes ☐ No ☐

7. Is your maths teacher male or female?

Male ☐ Female ☐ One Male AND One Female ☐

8. How well are you doing at maths?

Better than expected ☐ As expected ☐ Not as well as expected ☐

	Confidence On a scale of 1-5 (1 = Not at all confident – 5 = very confident) how confident do you feel with the topics below				
Number					
Order positive and negative numbers	1	2	3	4	5
Use prime numbers, factors, multiples, highest common factor and lowest common multiple	1	2	3	4	5

Learning the Number topic in maths will help me to pass my maths exam

Yes ☐ No ☐

Learning the Number topic in maths will give me more career opportunities

Yes ☐ No ☐

I will use the Number topic I learn in maths in everyday life

Yes ☐ No ☐

	Confidence On a scale of 1-5 (1 = Not at all confident – 5 = very confident) how confident do you feel with the topics below				
Algebra					
Use and interpret algebraic notation 3y in place of y + y + y	1	2	3	4	5
Produce graphs of linear and quadratic functions	1	2	3	4	5

Learning the Algebra topic in maths will help me to pass my maths exam

Yes ☐ No ☐

Learning the Algebra topic in maths will give me more career opportunities

Yes ☐ No ☐

I will use the Algebra topic I learn in maths in everyday life

Yes ☐ No ☐

	Confidence On a scale of 1-5 (1 = Not at all confident – 5 = very confident) how confident do you feel with the topics below				
Ratio, proportion and rates of change					
Change freely between standard units (time, length, volume)	1	2	3	4	5
Solve problems involving percentage change and simple interest	1	2	3	4	5

Learning the Ratio, proportion and rates of change topic in maths will help me to pass my maths exam

Yes ☐ No ☐

Learning the Ratio, proportion and rates of change topic in maths will give me more career opportunities

Yes ☐ No ☐

I will use the Ratio, proportion and rates of change topic I learn in maths in everyday life

Yes ☐ No ☐

	Confidence On a scale of 1-5 (1 = Not at all confident – 5 = very confident) how confident do you feel with the topics below				
Geometry and measures					
Solve problems involving area and perimeter (including circles)	1	2	3	4	5
Use Pythagoras Theorem to solve problems involving right angled triangles	1	2	3	4	5

Learning the Geometry and measure topic in maths will help me to pass my maths exam

Yes ☐ No ☐

Learning the Geometry and measure topic in maths will give me more career opportunities

Yes ☐ No ☐

I will use the Geometry and measure topic I learn in maths in everyday life

Yes ☐ No ☐

	Confidence On a scale of 1-5 (1 = Not at all confident – 5 = very confident) how confident do you feel with the topics below				
Probability					
Understand that the probability of all outcomes sum to 1	1	2	3	4	5
Record, describe and analyse the frequency of graphs	1	2	3	4	5

Learning the Probability topic in maths will help me to pass my maths exam

Yes ☐ No ☐

Learning the Probability topic in maths will give me more career opportunities

Yes ☐ No ☐

I will use the Probability topic I learn in maths in everyday life

Yes ☐ No ☐

	Confidence On a scale of 1-5 (1 = Not at all confident – 5 = very confident) how confident do you feel with the topics below				
Statistics					
Describe, interpret, and compare data (mean, median, mode)	1	2	3	4	5
Construct and interpret tables, charts and diagrams including frequency tables, bar charts and pie charts	1	2	3	4	5

Learning the Statistics topic in maths will help me to pass my maths exam

Yes ☐ No ☐

Learning the Statistics topic in maths will give me more career opportunities

Yes ☐ No ☐

I will use the Statistics topic I learn in maths in everyday life

Yes ☐ No ☐

Please tick the box which best describes how you think your friends feel

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
My friends like maths					
My friends think maths is important					
My friends think maths is boring					
My friends do maths outside of school					

Please tick the box which best describes how you feel

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I like maths					
I do maths at home					
Maths is hard					
I am good at maths					
I do not like maths					
Maths is easy					
I need GCSE maths to get a good job					
I think maths is important					
I enjoy maths when in class					
I like my maths teacher					
GCSE maths is relevant to everyday life					
Maths is boring					

Thank you for completing the questionnaire

Manchester Metropolitan University

Parent/Guardian Questionnaire

Child's Name:

Child's Maths Teachers Name:

Maths set:

1. Are you a…

Parent ☐ Guardian ☐

2. What is your gender?

Male ☐ Female ☐ Other ☐

3. What is your ethnicity?

White	British	
	Irish	
	Other white background	
Asian or Asian British	Indian	
	Pakistani	
	Bangladeshi	
	Any other Asian background	
Chinese	British Chinese	
	Chinese	
Black or Black British	African	
	Caribbean	
	Any other black background	
Mixed	White and Asian	
	White and Black	
	White and Chinese	
	White and any other	

4. Do you speak English as an additional language?

Yes ☐ No ☐

5. Is your child entitled to free school meals?

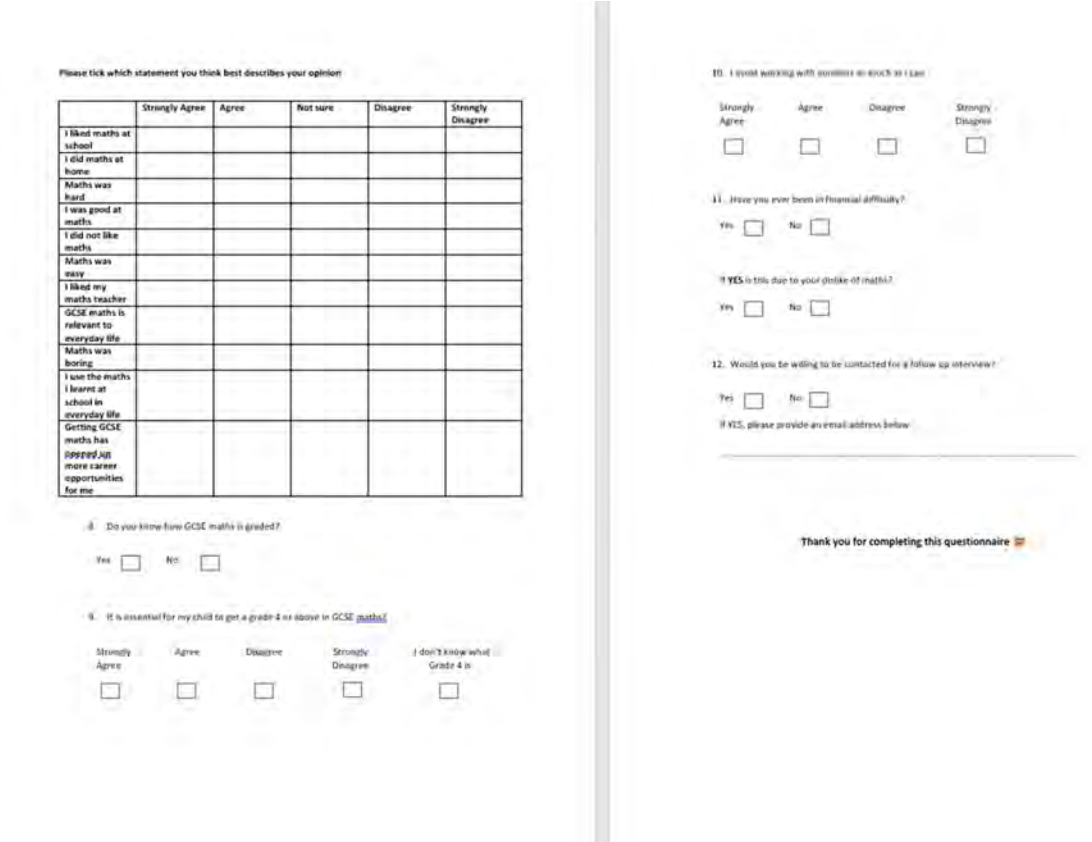
Yes ☐ No ☐

6. Does your child have extra maths tuition outside of school?

Yes ☐ No ☐

7. Do you help your child with their maths homework?

Yes ☐ No ☐



Please tick which statement you think best describes your opinion

	Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree
I liked maths at school					
I did maths at home					
Maths was hard					
I was good at maths					
I did not like maths					
Maths was easy					
I liked my maths teacher					
GCSE maths is relevant to everyday life					
Maths was boring					
I use the maths I learnt at school in everyday life					
Getting GCSE maths has opened up more career opportunities for me					

8. Do you know how GCSE maths is graded?

Yes ☐ No ☐

9. It is essential for my child to get a grade 4 or above in GCSE maths?

Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ I don't know what Grade 4 is ☐

10. I avoid working with numbers as much as I can

Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐

11. Have you ever been in financial difficulty?

Yes ☐ No ☐

If **YES** is this due to your dislike of maths?

Yes ☐ No ☐

12. Would you be willing to be contacted for a follow up interview?

Yes ☐ No ☐

If YES, please provide an email address below

Thank you for completing this questionnaire

Appendix B: Hypothesis

Appendix B.1: In School value

Gender

Null Hypothesis: There will not be a significant difference between gender and pupils in school value of Mathematics

Research Hypothesis: There will be a difference between gender and pupils in school value of Mathematics

Ethnicity

Null Hypothesis: There will not be a significant difference between ethnicity and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between ethnicity and pupils in school value of Mathematics

English as an additional language

Null Hypothesis: There will not be a significant difference between those who speak English as an additional language and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between those who speak English as an additional language and pupils in school value of Mathematics

Free School Meal Eligibility

Null Hypothesis: There will not be a significant difference between free school meal eligibility and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between free school meal eligibility and pupils in school value of Mathematics

Extra Maths Tuition

Null Hypothesis: There will not be a significant difference between those who have extra maths tuition and in school value of Mathematics

Research Hypothesis: There will be a significant difference between those who have extra maths tuition and pupils in school value of Mathematics

Parents help with homework

Null Hypothesis: There will not be a significant difference between those who parents help with their maths homework and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between those who parents help with their maths homework and pupils in school value of Mathematics

Teacher Gender

Null Hypothesis: There will not be a significant difference between the gender of their maths teacher and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between the gender of their maths teacher and pupils in school value of Mathematics

Parents Gender

Null Hypothesis: There will not be a significant difference between parents gender and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference parents gender and pupils in school value of Mathematics

Parents Ethnicity

Null Hypothesis: There will not be a significant difference between parents ethnicity and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between parents ethnicity and pupils in school value of Mathematics

Parents speak English as an additional language

Null Hypothesis: There will not be a significant difference between whether parents speak English as an additional language and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between whether parents speak English as an additional language and pupils in school value of Mathematics

Parents' attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive parents attitudes and pupils in school value of Mathematics

Research Hypothesis: There will be a significant relationship between positive parents attitudes and pupils in school value of Mathematics

Peer attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive peer attitudes and pupils in school value of Mathematics

Research Hypothesis: There will be a significant relationship between positive peer attitudes and pupils in school value of Mathematics

Pupil attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive pupils' attitudes and pupils in school value of Mathematics

Research Hypothesis: There will be a significant relationship between positive pupils' attitudes and pupils in school value of Mathematics

Regression Model

Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will not be significantly different than the one without, when predicting the influences of pupils In-School Value of mathematics.

Research Hypothesis: Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will be significantly different than the one without, when predicting the influences of pupils In-School Value of mathematics.

Appendix B.2: Out-School Value

Gender

Null Hypothesis: There will not be a significant difference between gender and pupils out school value of Mathematics

Research Hypothesis: There will be a difference between gender and pupils out school value of Mathematics

Ethnicity

Null Hypothesis: There will not be a significant difference between ethnicity and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between ethnicity and pupils out school value of Mathematics

Speak English as an additional language

Null Hypothesis: There will not be a significant difference between those who speak English as an additional language and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between those who speak English as an additional language and pupils out school value of Mathematics

Free School Meal Eligibility

Null Hypothesis: There will not be a significant difference between free school meal eligibility and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between free school meal eligibility and pupils out school value of Mathematics

Extra Maths Tuition

Null Hypothesis: There will not be a significant difference between those who have extra maths tuition and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between those who have extra maths tuition and pupils out school value of Mathematics

Parents help with homework

Null Hypothesis: There will not be a significant difference between those who parents help with their maths homework and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between those who parents help with their maths homework and pupils out school value of Mathematics

Teacher Gender

Null Hypothesis: There will not be a significant difference between the gender of their maths teacher and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between the gender of their maths teacher and pupils out school value of Mathematics

Parents Gender

Null Hypothesis: There will not be a significant difference between parents gender and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference parents gender and pupils out school value of Mathematics

Parents Ethnicity

Null Hypothesis: There will not be a significant difference between parents ethnicity and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between parents ethnicity and pupils out school value of Mathematics

Parents speak English as an additional language

Null Hypothesis: There will not be a significant difference between whether parents speak English as an additional language and pupils out school value of Mathematics

Research Hypothesis: There will be a significant difference between whether parents speak English as an additional language and pupils out school value of Mathematics

Parents attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive parents attitudes and pupils out school value of Mathematics

Research Hypothesis: There will be a significant relationship between positive parents attitudes and pupils out school value of Mathematics

Peer attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive peer attitudes and pupils out school value of Mathematics

Research Hypothesis: There will be a significant relationship between positive peer attitudes and pupils out school value of Mathematics

Pupils' attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive pupils' attitudes and pupils out school value of Mathematics

Research Hypothesis: There will be a significant relationship between positive pupils' attitudes and pupils out school value of Mathematics

Regression Model

Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will not be significantly different than the one without, when predicting the influences of pupils Out-School Value of mathematics.

Research Hypothesis: Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will be significantly different than the one without, when predicting the influences of pupils Out-School Value of mathematics.

Appendix B.3: Relevance

Gender

Null Hypothesis: There will not be a significant difference between gender and pupils relevance of Mathematics

Research Hypothesis: There will be a difference between gender and pupils relevance of Mathematics

Ethnicity

Null Hypothesis: There will not be a significant difference between ethnicity and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between ethnicity and pupils relevance of value of Mathematics

English as an additional language

Null Hypothesis: There will not be a significant difference between those who speak English as an additional language and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between those who speak English as an additional language and pupils relevance of Mathematics

Free School Meal Eligability

Null Hypothesis: There will not be a significant difference between free school meal eligibility and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between free school meal eligibility and pupils relevance of Mathematics

Extra Maths Tuition

Null Hypothesis: There will not be a significant difference between those who have extra maths tuition and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between those who have extra maths tuition and pupils relevance of Mathematics

Parents' help with homework

Null Hypothesis: There will not be a significant difference between those who parents help with their maths homework and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between those who parents help with their maths homework and pupils relevance of Mathematics

Teacher Gender

Null Hypothesis: There will not be a significant difference between the gender of their maths teacher pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between the gender of their maths teacher and pupils relevance of Mathematics

Parents Gender

Null Hypothesis: There will not be a significant difference between parents gender and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference parents gender and pupils in relevance of Mathematics

Parents Ethnicity

Null Hypothesis: There will not be a significant difference between parents ethnicity and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between parents ethnicity and pupils relevance of Mathematics

Parents speak English as an additional language

Null Hypothesis: There will not be a significant difference between whether parents speak English as an additional language and pupils relevance of Mathematics

Research Hypothesis: There will be a significant difference between whether parents speak English as an additional language and pupils relevance of Mathematics

Parents attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive parents attitudes and pupils relevance of Mathematics

Research Hypothesis: There will be a significant relationship between positive parents attitudes and pupils relevance of Mathematics

Peer attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive peer attitudes and pupils relevance of Mathematics

Research Hypothesis: There will be a significant relationship between positive peer attitudes and pupils relevance of Mathematics

Pupils attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive pupils' attitudes and pupils relevance of Mathematics

Research Hypothesis: There will be a significant relationship between positive pupils' attitudes and pupils relevance of Mathematics

Regression Model

Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will not be significantly different than the one without, when predicting the influences of pupils relevance of mathematics.

Research Hypothesis: Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will be significantly different than the one without, when predicting the influences of pupils relevance of mathematics.

Appendix B.4: Confidence

Gender

Null Hypothesis: There will not be a significant difference between gender and pupils mathematical confidence

Research Hypothesis: There will be a difference between gender and pupils mathematical confidence

Ethnicity

Null Hypothesis: There will not be a significant difference between ethnicity and pupils mathematical confidence

Research Hypothesis: There will be a significant difference between ethnicity and pupils mathematical confidence

Speak English as an additional language

Null Hypothesis: There will not be a significant difference between those who speak English as an additional language and pupils mathematical confidence

Research Hypothesis: There will be a significant difference between those who speak English as an additional language and pupils mathematical confidence

Free School Meal Eligability

Null Hypothesis: There will not be a significant difference between free school meal eligibility and pupils mathematical confidence

Research Hypothesis: There will be a significant difference between free school meal eligibility and pupils mathematical confidence

Extra Maths Tuition

Null Hypothesis: There will not be a significant difference between those who have extra maths tuition and pupils mathematical confidence

Research Hypothesis: There will be a significant difference between those who have extra maths tuition and pupils mathematical confidence

Parents help with homework

Null Hypothesis: There will not be a significant difference between those who parents help with their maths homework and pupils mathematical confidence

Research Hypothesis: There will be a significant difference between those who parents help with their maths homework and pupils mathematical confidence

Teacher Gender

Null Hypothesis: There will not be a significant difference between the gender of their maths teacher and pupils mathematical confidence

Research Hypothesis: There will be a significant difference between the gender of their maths teacher and pupils mathematical confidence

Parents Gender

Null Hypothesis: There will not be a significant difference between parents gender and pupils mathematical confidence

Research Hypothesis: There will be a significant difference parents gender and pupils mathematical confidence

Parents Ethnicity

Null Hypothesis: There will not be a significant difference between parents ethnicity and pupils in school value of Mathematics

Research Hypothesis: There will be a significant difference between parents ethnicity and pupils mathematical confidence

Parents speak English as an additional language

Null Hypothesis: There will not be a significant difference between whether parents speak English as an additional language and pupils mathematical confidence

Research Hypothesis: There will be a significant difference between whether parents speak English as an additional language and pupils mathematical confidence

Parents attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive parents attitudes and pupils mathematical confidence

Research Hypothesis: There will be a significant relationship between positive parents attitudes and pupils mathematical confidence

Peer attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive peer attitudes and pupils mathematical confidence

Research Hypothesis: There will be a significant relationship between positive peer attitudes and pupils mathematical confidence

Pupils attitudes towards mathematics

Null Hypothesis: There will not be a significant relationship between positive pupils' attitudes and pupils mathematical confidence

Research Hypothesis: There will be a significant relationship between positive pupils' attitudes and pupils mathematical confidence

Regression Model

Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will not be significantly different than the one without, when predicting the influences of pupils mathematical confidence.

Research Hypothesis: Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will be significantly different than the one without, when predicting the influences of pupils mathematical confidence.

Appendix B.5: Mathematical Habitus

Regression Model

Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will not be significantly different than the one without, when predicting the influences of pupils Mathematical Habitus.

Research Hypothesis: Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes and parent attitudes will be significantly different than the one without, when predicting the influences of pupils Mathematical Habitus.

Multi-Level Model

Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes, parent attitudes and school will not be significantly different than the one without, when predicting the influences of pupils Mathematical Habitus.

Research Hypothesis: Null Hypothesis: The model containing gender, ethnicity, speaking English as an additional language, free school meal eligibility, teacher gender, peer attitudes, parent attitudes and school will be significantly different than the one without, when predicting the influences of pupils Mathematical Habitus.

Appendix C: Measures

Appendix C.1: Pupils’ attitudes

Massey’s (2019) measure

Correlation Matrix

		I liked maths at school	I was good at maths at school	Maths was easy	GCSE maths is relevant to everydaylife	I use the maths I learnt at school everyday	GCSE maths has opened up more career opportunities for me
Correlation	I liked maths at school	1.000	.699	.507	.452	.506	.460
	I was good at maths at school	.699	1.000	.599	.299	.417	.427
	Maths was easy	.507	.599	1.000	.256	.260	.298
	GCSE maths is relevant to everydaylife	.452	.299	.256	1.000	.778	.507
	I use the maths I learnt at school everyday	.506	.417	.260	.778	1.000	.614
	GCSE maths has opened up more career opportunities for me	.460	.427	.298	.507	.614	1.000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.767
Bartlett's Test of Sphericity	Approx. Chi-Square	377.170
	df	15
	Sig.	<.001

Factor Matrix[a]

	Factor 1	Factor 2
I liked maths at school	.761	
I was good at maths at school	.758	.503
Maths was easy	.544	
GCSE maths is relevant to everydaylife	.704	-.411
I use the maths I learnt at school everyday	.832	-.468
GCSE maths has opened up more career opportunities for me	.651	

Extraction Method: Principal Axis Factoring.

a. 2 factors extracted. 18 iterations required.

Harris attitudes measure

Pattern Matrix[a]

	Factor			
	1	2	3	4
I like maths	.468			
I do not like maths	-.898			
Maths is easy		-.909		
Maths is hard		.774		
I think maths is important			.745	
I enjoy maths when in class				.697
I am good at maths		-.546		
I do maths at home				
GCSE maths is relevant to everyday life			.668	
I like my maths teacher				.633
I think maths is boring	-.658			

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Correlation Matrix

		I like maths	I do not like maths	Maths is easy	Maths is hard	I think maths is important	I enjoy maths when in class	I am good at maths	I do maths at home	GCSE maths is relevant to everyday life	I like my maths teacher	I think maths is boring
Correlation	I like maths	1.000	-.701	.424	-.287	.456	.732	.544	.476	.346	.394	-.617
	I do not like maths	-.701	1.000	-.332	.324	-.330	-.591	-.396	-.319	-.246	-.296	.659
	Maths is easy	.424	-.332	1.000	-.670	.170	.342	.555	.196	.145	.111	-.331
	Maths is hard	-.287	.324	-.670	1.000	-.044	-.214	-.461	-.080	-.040	-.025	.287
	I think maths is important	.456	-.330	.170	-.044	1.000	.456	.285	.359	.496	.286	-.317
	I enjoy maths when in class	.732	-.591	.342	-.214	.456	1.000	.435	.408	.366	.518	-.564
	I am good at maths	.544	-.396	.555	-.461	.285	.435	1.000	.289	.175	.152	-.375
	I do maths at home	.476	-.319	.196	-.080	.359	.408	.289	1.000	.294	.209	-.386
	GCSE maths is relevant to everyday life	.346	-.246	.145	-.040	.496	.366	.175	.294	1.000	.180	-.285
	I like my maths teacher	.394	-.296	.111	-.025	.286	.518	.152	.209	.180	1.000	-.331
	I think maths is boring	-.617	.659	-.331	.287	-.317	-.564	-.375	-.386	-.285	-.331	1.000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.856
Bartlett's Test of Sphericity	Approx. Chi-Square	7192.942
	df	55
	Sig.	.000

Reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.913	.911	11

Inter-Item Correlation Matrix

	I like maths	Maths is easy	I think maths is important	I enjoy maths when in class	I am good at maths	I do maths at home	GCSE maths is relevant to everyday life	I like my maths teacher	I do not like maths	Maths is hard	Maths is boring
I like maths	1.000	.587	.554	.866	.662	.720	.528	.503	.705	.376	.709
Maths is easy	.587	1.000	.404	.478	.702	.461	.338	.247	.462	.726	.466
I think maths is important	.554	.404	1.000	.580	.467	.493	.617	.411	.362	.185	.448
I enjoy maths when in class	.866	.478	.580	1.000	.573	.667	.552	.588	.668	.273	.724
I am good at maths	.662	.702	.467	.573	1.000	.557	.379	.272	.491	.516	.473
I do maths at home	.720	.461	.493	.667	.557	1.000	.447	.358	.498	.235	.558
GCSE maths is relevant to everyday life	.528	.338	.617	.552	.379	.447	1.000	.323	.331	.128	.441
I like my maths teacher	.503	.247	.411	.588	.272	.358	.323	1.000	.327	.106	.462
I do not like maths	.705	.462	.362	.668	.491	.498	.331	.327	1.000	.458	.740
Maths is hard	.376	.726	.185	.273	.516	.235	.128	.106	.458	1.000	.377
Maths is boring	.709	.466	.448	.724	.473	.558	.441	.462	.740	.377	1.000

Item-Total Statistics

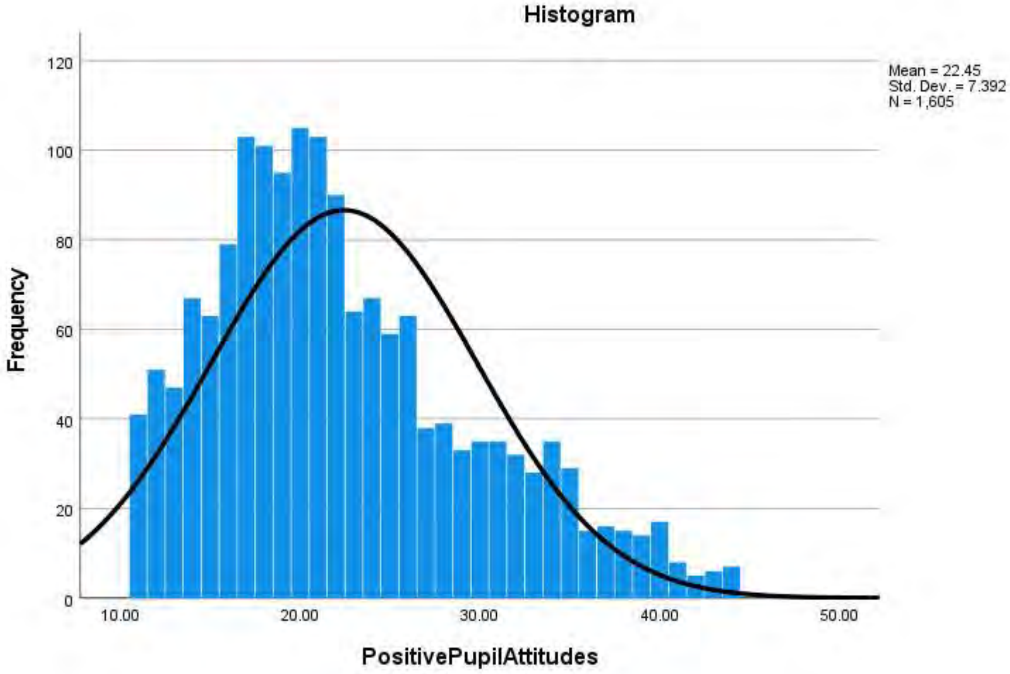
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I like maths	27.0881	58.950	.875	.834	.893
Maths is easy	27.2797	64.425	.662	.707	.905
I think maths is important	26.3678	66.633	.613	.500	.908
I enjoy maths when in class	27.1073	60.419	.839	.815	.895
I am good at maths	26.8199	64.310	.697	.610	.903
I do maths at home	27.1609	63.382	.687	.557	.904
GCSE maths is relevant to everyday life	26.8467	65.999	.547	.455	.911
I like my maths teacher	26.6590	67.049	.484	.387	.914
I do not like maths	26.9923	62.285	.700	.660	.903
Maths is hard	27.2222	67.712	.450	.605	.915
Maths is boring	27.2375	61.166	.752	.664	.900

Descriptives

Statistics

PositivePupilAttitudes

N	Valid	1605
	Missing	154
Mean		22.4461
Median		21.0000
Mode		20.00
Std. Deviation		7.39172
Range		33.00
Minimum		11.00
Maximum		44.00



Appendix C.2: Peer attitudes

Reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.684	.687	4

Inter-Item Correlation Matrix

	My friends like maths	My friends think maths is important	My friends do maths outside of school	My friends think maths is boring
My friends like maths	1.000	.573	.451	.286
My friends think maths is important	.573	1.000	.394	.219
My friends do maths outside of school	.451	.394	1.000	.205
My friends think maths is boring	.286	.219	.205	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
My friends like maths	6.1844	4.605	.609	.406	.527
My friends think maths is important	5.5461	4.611	.532	.353	.574
My friends do maths outside of school	6.3918	5.180	.460	.235	.624
My friends think maths is boring	6.2287	5.569	.293	.092	.729

Reliability after removing item

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.718	.717	3

Inter-Item Correlation Matrix

	My friends like maths	My friends think maths is important	My friends do maths outside of school
My friends like maths	1.000	.568	.439
My friends think maths is important	.568	1.000	.367
My friends do maths outside of school	.439	.367	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
My friends like maths	4.4395	2.652	.611	.384	.536
My friends think maths is important	3.7994	2.670	.553	.340	.610
My friends do maths outside of school	4.7198	3.128	.454	.213	.724

Validity

Correlation Matrix

		My friends like maths	My friends think maths is important	My friends do maths outside of school
Correlation	My friends like maths	1.000	.568	.439
	My friends think maths is important	.568	1.000	.367
	My friends do maths outside of school	.439	.367	1.000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.648
Bartlett's Test of Sphericity	Approx. Chi-Square	409.161
	df	3
	Sig.	<.001

Factor Matrix[a]

	Factor 1
My friends like maths	.821
My friends think maths is important	.691
My friends do maths outside of school	.533

Extraction Method: Principal Axis Factoring.

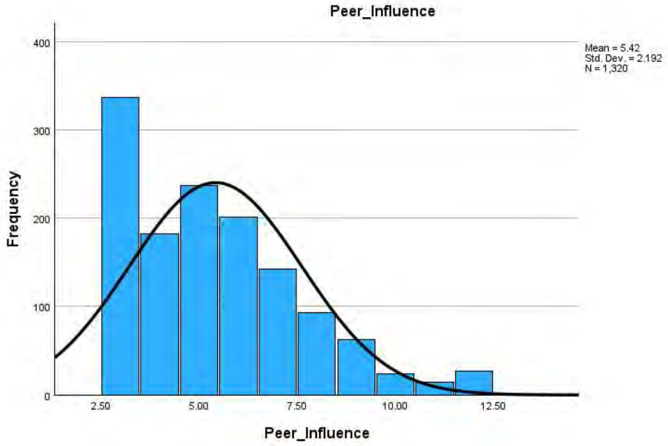
a. 1 factors extracted. 17 iterations required.

Peer descriptives

Statistics

Peer_Influence

N	Valid	1320
	Missing	439
Mean		5.4189
Median		5.0000
Mode		3.00
Std. Deviation		2.19230
Range		9.00
Minimum		3.00
Maximum		12.00



Appendix C.3: Parent attitudes

Validity

Correlation Matrix

		I liked maths at school	I was good at maths at school	Maths was easy	GCSE maths is relevant to everydaylife	I use the maths I learnt at school everyday	GCSE maths has opened up more career opportunities for me
Correlation	I liked maths at school	1.000	.699	.507	.452	.506	.460
	I was good at maths at school	.699	1.000	.599	.299	.417	.427
	Maths was easy	.507	.599	1.000	.256	.260	.298
	GCSE maths is relevant to everydaylife	.452	.299	.256	1.000	.778	.507
	I use the maths I learnt at school everyday	.506	.417	.260	.778	1.000	.614
	GCSE maths has opened up more career opportunities for me	.460	.427	.298	.507	.614	1.000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.767
Bartlett's Test of Sphericity	Approx. Chi-Square	377.170
	df	15
	Sig.	<.001

Factor Matrix[a]		
	Factor	
	1	2
I liked maths at school	.761	
I was good at maths at school	.758	.503
Maths was easy	.544	
GCSE maths is relevant to everydaylife	.704	-.411
I use the maths I learnt at school everyday	.832	-.468
GCSE maths has opened up more career opportunities for me	.651	

Extraction Method: Principal Axis Factoring.

a. 2 factors extracted. 18 iterations required.

Parents reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.836	.844	6

Inter-Item Correlation Matrix

	I liked maths	I was good at maths at school	Maths was easy	GCSE maths is relevant to everydaylife	I use the maths I learnt at school everyday	GCSE maths has opened up more career opportunities for me
I liked maths	1.000	.666	.503	.477	.529	.483
I was good at maths at school	.666	1.000	.599	.299	.417	.427
Maths was easy	.503	.599	1.000	.256	.260	.298
GCSE maths is relevant to everydaylife	.477	.299	.256	1.000	.778	.507
I use the maths I learnt at school everyday	.529	.417	.260	.778	1.000	.614
GCSE maths has opened up more career opportunities for me	.483	.427	.298	.507	.614	1.000

Item-Total Statistics

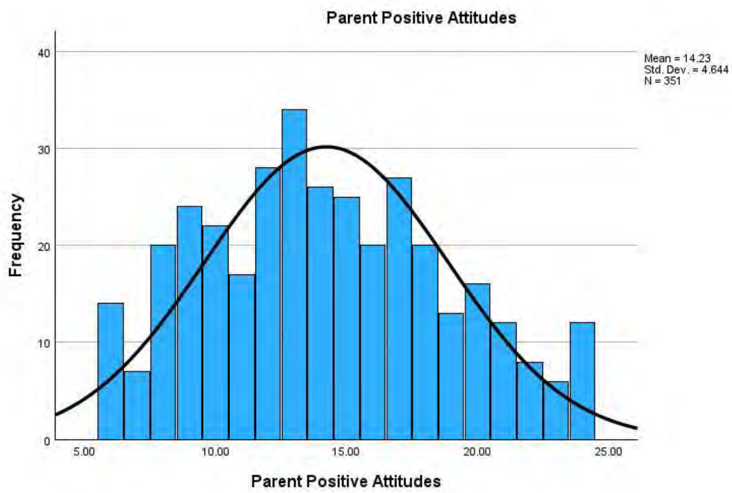
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I liked maths	18.2748	21.647	.710	.553	.798
I was good at maths at school	17.6260	20.636	.626	.562	.806
Maths was easy	18.3740	21.221	.475	.388	.838
GCSE maths is relevant to everydaylife	17.4580	20.712	.611	.625	.809
I use the maths I learnt at school everyday	17.6641	19.486	.695	.690	.791
GCSE maths has opened up more career opportunities for me	17.7786	19.189	.610	.423	.811

Descriptives

Statistics

Parent Positive Attitudes

N	Valid	351
	Missing	1408
Mean		14.2251
Median		14.0000
Mode		13.00
Std. Deviation		4.64365
Range		18.00
Minimum		6.00
Maximum		24.00



Appendix C.4: Validity of in school value, out school value, relevance and confidence

Rotated Factor Matrix[a]

	Factor					
	1	2	3	4	5	6
Learning the number topic in maths will help me to pass my maths exam	.517					
Learning the number topic in maths will give me more career opportunities		.545				
I will use the number topic I learn in maths in everyday life			.452			
Learning the algebra topic in maths will help me to pass my maths exam	.619					
Learning the algebra topic in maths will give me more career opportunities		.633				
I will use the algebra topic I learn in maths in everyday life			.628			
Learning the ratio, proportion and rates of change topic in maths will help me to pass my maths exam	.723					
Learning the ratio, proportion and rates of change topic in maths will give me more career opportunities		.663				
I will use the ratio, proportion and rates of change topic I learn in maths in everyday life			.698			
Learning the geometry and measures topic in maths will help me to pass my maths exam	.697					
Learning the geometry and measures topic in maths will give me more career opportunities		.736				
I will use the geometry and measures topic I learn in maths in everyday life			.692			
Learning the probability topic in maths will help me to pass my maths exam	.686					
Learning the probability topic in maths will give me more career opportunities		.709				
I will use the probability topic I learn in maths in everyday life			.685			
Learning the statistics topic in maths will help me to pass my maths exam	.737					
Learning the statistics topic in maths will give me more career opportunities		.654				
I will use the statistics topic I learn in maths in everyday life			.714			
I need GCSE maths to get a good job				.682		
I think maths is important				.680		
GCSE maths is relevant to everyday life				.571		

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

Appendix C.5: In-School value

Reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.838	.838	6

Inter-Item Correlation Matrix

	Learning the number topic in maths will help me to pass my maths exam	Learning the algebra topic in maths will help me to pass my maths exam	Learning the ratio, proportion and rates of change topic in maths will help me to pass my maths exam	Learning the geometry and measures topic in maths will help me to pass my maths exam	Learning the probability topic in maths will help me to pass my maths exam	Learning the statistics topic in maths will help me to pass my maths exam
Learning the number topic in maths will help me to pass my maths exam	1.000	.348	.402	.371	.368	.429
Learning the algebra topic in maths will help me to pass my maths exam	.348	1.000	.476	.470	.431	.453
Learning the ratio, proportion and rates of change topic in maths will help me to pass my maths exam	.402	.476	1.000	.518	.546	.555
Learning the geometry and measures topic in maths will help me to pass my maths exam	.371	.470	.518	1.000	.496	.534
Learning the probability topic in maths will help me to pass my maths exam	.368	.431	.546	.496	1.000	.557
Learning the statistics topic in maths will help me to pass my maths exam	.429	.453	.555	.534	.557	1.000

Item-Total Statistics

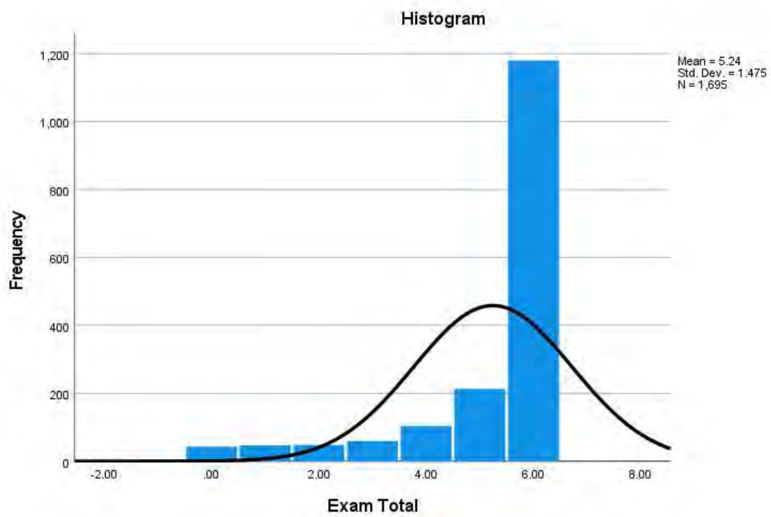
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Learning the number topic in maths will help me to pass my maths exam	5.5447	1.462	.493	.248	.834
Learning the algebra topic in maths will help me to pass my maths exam	5.5391	1.400	.572	.332	.820
Learning the ratio, proportion and rates of change topic in maths will help me to pass my maths exam	5.5403	1.344	.670	.455	.801
Learning the geometry and measures topic in maths will help me to pass my maths exam	5.5059	1.290	.636	.411	.808
Learning the probability topic in maths will help me to pass my maths exam	5.5260	1.326	.639	.426	.807
Learning the statistics topic in maths will help me to pass my maths exam	5.5397	1.336	.680	.469	.799

Descriptives

Statistics

Exam Total

N	Valid	1695
	Missing	64
Mean		5.2413
Median		6.0000
Mode		6.00
Std. Deviation		1.47476
Range		6.00
Minimum		.00
Maximum		6.00



Appendix C.6: Out-School value

Reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.860	.860	6

Inter-Item Correlation Matrix

	Learning the number topic in maths will give me more career opportunities	Learning the algebra topic in maths will give me more career opportunities	Learning the ratio, proportion and rates of change topic in maths will give me more career opportunities	Learning the geometry and measures topic in maths will give me more career opportunities	Learning the probability topic in maths will give me more career opportunities	Learning the statistics topic in maths will give me more career opportunities
Learning the number topic in maths will give me more career opportunities	1.000	.440	.460	.426	.458	.425
Learning the algebra topic in maths will give me more career opportunities	.440	1.000	.508	.537	.512	.471
Learning the ratio, proportion and rates of change topic in maths will give me more career opportunities	.460	.508	1.000	.549	.559	.525
Learning the geometry and measures topic in maths will give me more career opportunities	.426	.537	.549	1.000	.591	.549
Learning the probability topic in maths will give me more career opportunities	.458	.512	.559	.591	1.000	.575
Learning the statistics topic in maths will give me more career opportunities	.425	.471	.525	.549	.575	1.000

Item-Total Statistics

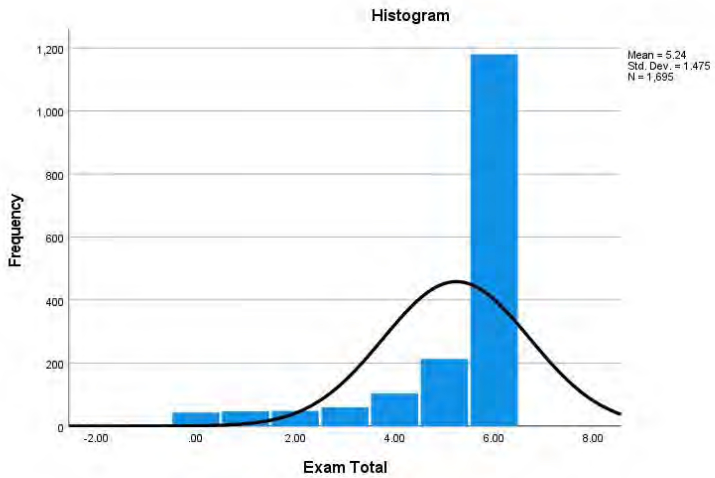
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Learning the number topic in maths will give me more career opportunities	6.8912	3.665	.557	.313	.853
Learning the algebra topic in maths will give me more career opportunities	6.7298	3.408	.633	.404	.840
Learning the ratio, proportion and rates of change topic in maths will give me more career opportunities	6.7990	3.388	.673	.453	.833
Learning the geometry and measures topic in maths will give me more career opportunities	6.7676	3.341	.689	.485	.830
Learning the probability topic in maths will give me more career opportunities	6.7478	3.307	.701	.500	.827
Learning the statistics topic in maths will give me more career opportunities	6.8777	3.499	.656	.441	.836

Descriptives

Statistics

Exam Total

N	Valid	1695
	Missing	64
Mean		5.2413
Median		6.0000
Mode		6.00
Std. Deviation		1.47476
Range		6.00
Minimum		.00
Maximum		6.00



Appendix C.7: Relevance

Reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.825	.827	6

Inter-Item Correlation Matrix

	I will use the number topic I learn in maths in everyday life	I will use the algebra topic I learn in maths in everyday life	I will use the ratio, proportion and rates of change topic I learn in maths in everyday life	I will use the geometry and measures topic I learn in maths in everyday life	I will use the probability topic I learn in maths in everyday life	I will use the statistics topic I learn in maths in everyday life
I will use the number topic I learn in maths in everyday life	1.000	.358	.347	.332	.340	.357
I will use the algebra topic I learn in maths in everyday life	.358	1.000	.440	.476	.463	.405
I will use the ratio, proportion and rates of change topic I learn in maths in everyday life	.347	.440	1.000	.537	.510	.540
I will use the geometry and measures topic I learn in maths in everyday life	.332	.476	.537	1.000	.502	.507
I will use the probability topic I learn in maths in everyday life	.340	.463	.510	.502	1.000	.532
I will use the statistics topic I learn in maths in everyday life	.357	.405	.540	.507	.532	1.000

Item-Total Statistics

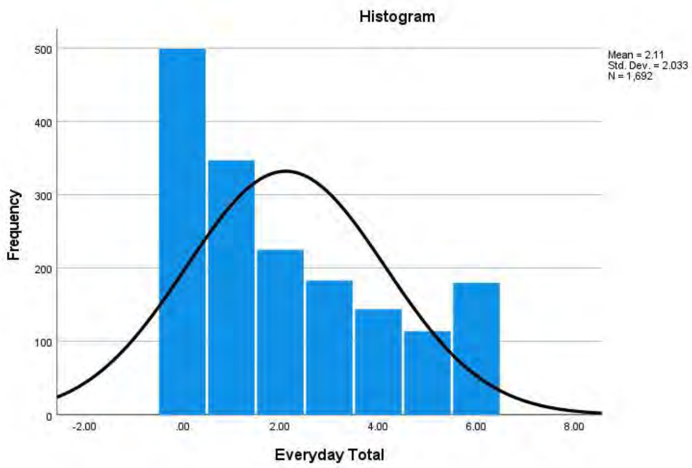
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I will use the number topic I learn in maths in everyday life	8.3817	3.235	.449	.206	.828
I will use the algebra topic I learn in maths in everyday life	8.0567	3.272	.571	.335	.802
I will use the ratio, proportion and rates of change topic I learn in maths in everyday life	8.2205	2.967	.645	.432	.786
I will use the geometry and measures topic I learn in maths in everyday life	8.1341	3.068	.637	.422	.788
I will use the probability topic I learn in maths in everyday life	8.1657	3.025	.636	.417	.788
I will use the statistics topic I learn in maths in everyday life	8.2386	2.971	.636	.423	.788

Descriptives

Statistics

Everyday Total

N	Valid	1692
	Missing	67
Mean		2.1111
Median		1.5000
Mode		.00
Std. Deviation		2.03272
Range		6.00
Minimum		.00
Maximum		6.00



Appendix C.8: Confidence

Reliability

Reliability Statistics

Cronbach's Alpha	N of Items
.913	10

Item-Total Statistics

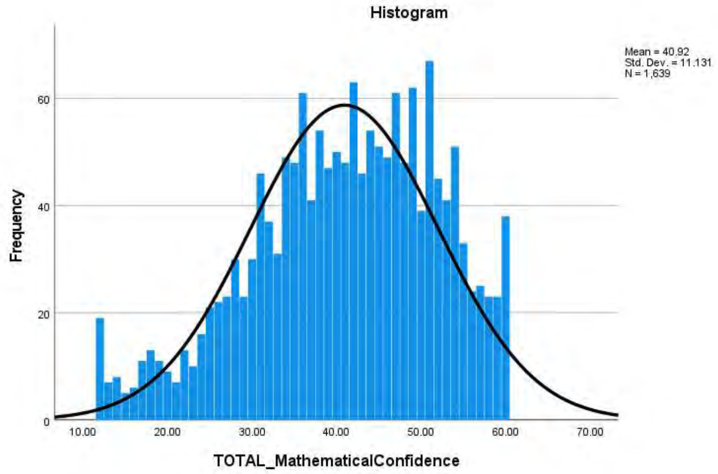
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Order positive and negative numbers	30.6338	69.799	.548	.911
Use prime numbers, factors, multiples, HCF and LCM	31.3474	65.294	.688	.903
Produce graphs of linear and quadradic functions	32.0201	64.716	.697	.903
Change freely between standard units (time, length, volume)	31.5014	64.324	.737	.900
Solve problems involving percentage change and simple interest	31.4570	63.926	.737	.900
Solve problems involving area and perimeter (including circles)	31.3849	64.505	.713	.902
Use Pythagoras Theorem to solve problems involving right angled triangles	32.0146	63.905	.576	.912
Record, describe and analyse the frequency of graphs	31.8051	63.782	.727	.901
Describe, interpret and compare data (mean, median, mode)	31.3058	64.161	.690	.903
Construct and interpret tables, charts and diagrams including frequency tables, bar charts and pie charts	31.4237	64.326	.721	.901

Descriptives

Statistics

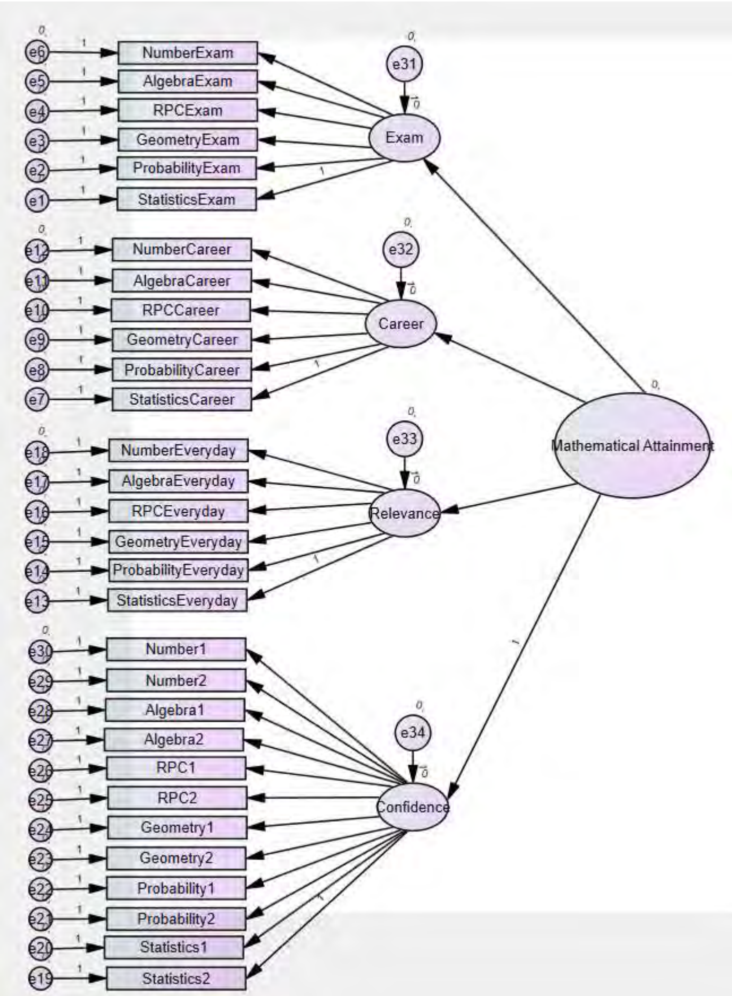
TOTAL_MathematicalConfidenc

N	Valid	1639
	Missing	120
Mean		40.9250
Median		42.0000
Mode		51.00
Std. Deviation		11.13097
Range		48.00
Minimum		12.00
Maximum		60.00



Appendix C.9: Mathematical Habitus

Structural Equation Model



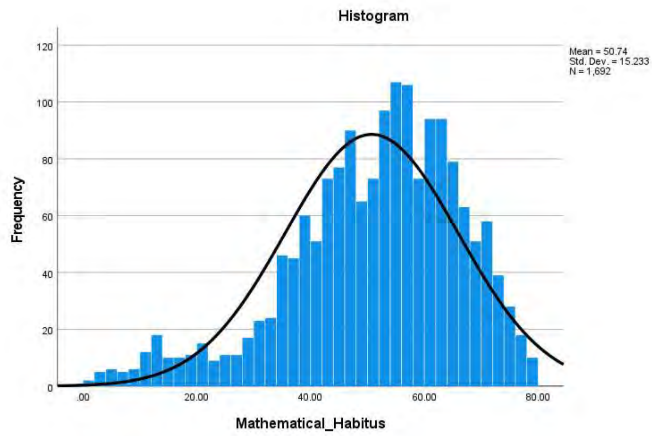
Mathematical habitus descriptives

Statistics

Mathematical_Habitus

N	Valid	1692
	Missing	67
Mean		50.7405
Median		53.0000
Mode		56.00[a]
Std. Deviation		15.23347
Range		77.00
Minimum		1.00
Maximum		78.00

a. Multiple modes exist. The smallest value is shown



Appendix D: Univariate analysis

Gender

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	990	56.3	59.1	59.1
	Female	641	36.4	38.3	97.4
	Other	44	2.5	2.6	100.0
	Total	1675	95.2	100.0	
Missing	System	84	4.8		
Total		1759	100.0		

English as an additional language

Do you speak English as an additional language?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	719	40.9	43.0	43.0
	No	953	54.2	57.0	100.0
	Total	1672	95.1	100.0	
Missing	System	87	4.9		
Total		1759	100.0		

Free School Meal Eligability

Do you have free school meals?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	522	29.7	31.3	31.3
	No	1148	65.3	68.7	100.0
	Total	1670	94.9	100.0	
Missing	System	89	5.1		
Total		1759	100.0		

Ethnicity

Before recoding

What is your ethnicity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White British	735	41.8	47.4	47.4
	White Irish	16	.9	1.0	48.4
	Other White background	66	3.8	4.3	52.7
	Indian	20	1.1	1.3	54.0
	Pakistani	305	17.3	19.7	73.6
	Bangladeshi	76	4.3	4.9	78.5
	Any other Asian background	49	2.8	3.2	81.7
	British Chinese	10	.6	.6	82.3
	Chinese	23	1.3	1.5	83.8
	African	134	7.6	8.6	92.5
	Caribbean	12	.7	.8	93.2
	Any other black background	22	1.3	1.4	94.6
	White and Asian	22	1.3	1.4	96.1
	White and Black	41	2.3	2.6	98.7
	White and Chinese	2	.1	.1	98.8
	White and any other	18	1.0	1.2	100.0
	Total	1551	88.2	100.0	
Missing	System	208	11.8		
Total		1759	100.0		

After recoding

What is your ethnicity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White	817	46.4	52.7	52.7
	South Asian	450	25.6	29.0	81.7
	Chinese	33	1.9	2.1	83.8
	Black	168	9.6	10.8	94.6
	Mixed	83	4.7	5.4	100.0
	Total	1551	88.2	100.0	
Missing	System	208	11.8		
Total		1759	100.0		

Extra maths tuition

Do you have extra maths tuition outside of school?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	143	8.1	8.5	8.5
	No	1539	87.5	91.5	100.0
	Total	1682	95.6	100.0	
Missing	System	77	4.4		
Total		1759	100.0		

Parents help with homework

Do your parents help you with your maths homework?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	430	24.4	25.9	25.9
	No	1233	70.1	74.1	100.0
	Total	1663	94.5	100.0	
Missing	System	96	5.5		
Total		1759	100.0		

Teacher gender

Is your maths teacher male or female?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	643	36.6	39.6	39.6
	Female	981	55.8	60.4	100.0
	Total	1624	92.3	100.0	
Missing	One Male and One Female	66	3.8		
	System	69	3.9		
	Total	135	7.7		
Total		1759	100.0		

Attitudes - before recoding into measure

I like maths

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	210	11.9	15.6	15.6
	Agree	515	29.3	38.4	54.0
	Disagree	320	18.2	23.8	77.9
	Strongly Disagree	297	16.9	22.1	100.0
	Total	1342	76.3	100.0	
Missing	Not Sure	324	18.4		
	System	93	5.3		
	Total	417	23.7		
Total		1759	100.0		

I do maths at home

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	156	8.9	10.7	10.7
	Agree	575	32.7	39.4	50.1
	Disagree	398	22.6	27.3	77.4
	Strongly Disagree	329	18.7	22.6	100.0
	Total	1458	82.9	100.0	
Missing	Not Sure	195	11.1		
	System	106	6.0		
	Total	301	17.1		
Total		1759	100.0		

Maths is hard

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	284	16.1	22.8	22.8
	Agree	549	31.2	44.1	66.9
	Disagree	310	17.6	24.9	91.8
	Strongly Disagree	102	5.8	8.2	100.0
	Total	1245	70.8	100.0	
Missing	Not Sure	390	22.2		
	System	124	7.0		
	Total	514	29.2		
Total		1759	100.0		

I am good at maths

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	221	12.6	19.5	19.5
	Agree	624	35.5	55.0	74.4
	Disagree	151	8.6	13.3	87.8
	Strongly Disagree	139	7.9	12.2	100.0
	Total	1135	64.5	100.0	
Missing	Not Sure	517	29.4		
	System	107	6.1		
	Total	624	35.5		
Total		1759	100.0		

I do not like maths

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	334	19.0	24.9	24.9
	Agree	364	20.7	27.2	52.1
	Disagree	413	23.5	30.8	82.9
	Strongly Disagree	229	13.0	17.1	100.0
	Total	1340	76.2	100.0	
Missing	Not Sure	309	17.6		
	System	110	6.3		
	Total	419	23.8		
Total		1759	100.0		

Maths is easy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	98	5.6	8.1	8.1
	Agree	313	17.8	26.0	34.1
	Disagree	512	29.1	42.5	76.6
	Strongly Disagree	282	16.0	23.4	100.0
	Total	1205	68.5	100.0	
Missing	Not Sure	427	24.3		
	82.00	1	.1		
	System	126	7.2		
	Total	554	31.5		
Total		1759	100.0		

I need GCSE maths to get a good job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	768	43.7	53.6	53.6
	Agree	544	30.9	38.0	91.6
	Disagree	80	4.5	5.6	97.1
	Strongly Disagree	41	2.3	2.9	100.0
	Total	1433	81.5	100.0	
Missing	Not Sure	236	13.4		
	System	90	5.1		
	Total	326	18.5		
Total		1759	100.0		

I think maths is important

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	653	37.1	45.4	45.4
	Agree	656	37.3	45.6	91.0
	Disagree	78	4.4	5.4	96.5
	Strongly Disagree	51	2.9	3.5	100.0
	Total	1438	81.8	100.0	
Missing	Not Sure	206	11.7		
	System	115	6.5		
	Total	321	18.2		
Total		1759	100.0		

I enjoy maths when in class

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	179	10.2	14.5	14.5
	Agree	468	26.6	37.8	52.3
	Disagree	317	18.0	25.6	77.9
	Strongly Disagree	273	15.5	22.1	100.0
	Total	1237	70.3	100.0	
Missing	Not Sure	402	22.9		
	System	120	6.8		
	Total	522	29.7		
Total		1759	100.0		

I like my maths teacher

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	474	26.9	35.6	35.6
	Agree	577	32.8	43.3	78.9
	Disagree	110	6.3	8.3	87.2
	Strongly Disagree	171	9.7	12.8	100.0
	Total	1332	75.7	100.0	
Missing	Not Sure	302	17.2		
	System	125	7.1		
	Total	427	24.3		
Total		1759	100.0		

GCSE maths is relevant to everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	315	17.9	26.5	26.5
	Agree	493	28.0	41.5	68.0
	Disagree	235	13.4	19.8	87.7
	Strongly Disagree	146	8.3	12.3	100.0
	Total	1189	67.6	100.0	
Missing	Not Sure	471	26.8		
	System	99	5.6		
	Total	570	32.4		
Total		1759	100.0		

Maths is boring

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	454	25.8	34.3	34.3
	Agree	411	23.4	31.0	65.3
	Disagree	280	15.9	21.1	86.4
	Strongly Disagree	180	10.2	13.6	100.0
	Total	1325	75.3	100.0	
Missing	Not Sure	335	19.0		
	System	99	5.6		
	Total	434	24.7		
Total		1759	100.0		

Peer attitudes – before recoding into measure

My friends like maths

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	79	4.5	7.0	7.0
	Agree	259	14.7	23.0	30.1
	Disagree	415	23.6	36.9	67.0
	Strongly Disagree	371	21.1	33.0	100.0
	Total	1124	63.9	100.0	
Missing	Not Sure	540	30.7		
	83.00	1	.1		
	System	94	5.3		
	Total	635	36.1		
Total		1759	100.0		

My friends think maths is important

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	227	12.9	19.2	19.2
	Agree	635	36.1	53.8	73.1
	Disagree	174	9.9	14.7	87.8
	Strongly Disagree	144	8.2	12.2	100.0
	Total	1180	67.1	100.0	
Missing	Not Sure	488	27.7		
	System	91	5.2		
	Total	579	32.9		
Total		1759	100.0		

My friends think maths is boring

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	512	30.2	30.7	30.7
	Agree	554	32.6	33.2	63.9
	Not Sure	380	22.4	22.8	86.7
	Disagree	119	7.0	7.1	93.9
	Strongly Disagree	102	6.0	6.1	100.0
	Total	1667	98.2	100.0	
Missing	System	31	1.8		
Total		1698	100.0		

My friends do maths outside of school

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	559	31.8	50.5	50.5
	Disagree	332	18.9	30.0	80.6
	Agree	150	8.5	13.6	94.1
	Strongly Agree	65	3.7	5.9	100.0
	Total	1106	62.9	100.0	
Missing	System	653	37.1		
Total		1759	100.0		

Value and relevance of curriculum

Learning the number topic in maths will help me to pass my maths exam

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1511	85.9	90.0	90.0
	No	167	9.5	10.0	100.0
	Total	1678	95.4	100.0	
Missing	System	81	4.6		
Total		1759	100.0		

Learning the number topic in maths will give me more career opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1204	68.4	72.4	72.4
	No	459	26.1	27.6	100.0
	Total	1663	94.5	100.0	
Missing	System	96	5.5		
Total		1759	100.0		

I will use the number topic I learn in maths in everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	888	50.5	53.9	53.9
	No	758	43.1	46.1	100.0
	Total	1646	93.6	100.0	
Missing	4.00	1	.1		
	System	112	6.4		
	Total	113	6.4		
Total		1759	100.0		

Learning the algebra topic in maths will help me to pass my maths exam

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1501	85.3	89.5	89.5
	No	177	10.1	10.5	100.0
	Total	1678	95.4	100.0	
Missing	System	81	4.6		
Total		1759	100.0		

Learning the algebra topic in maths will give me more career opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	949	54.0	57.0	57.0
	No	716	40.7	43.0	100.0
	Total	1665	94.7	100.0	
Missing	System	94	5.3		
Total		1759	100.0		

I will use the algebra topic I learn in maths in everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	364	20.7	21.9	21.9
	No	1300	73.9	78.1	100.0
	Total	1664	94.6	100.0	
Missing	3.00	1	.1		
	System	94	5.3		
	Total	95	5.4		
Total		1759	100.0		

Learning the ratio, proportion and rates of change topic in maths will help me to pass my maths exam

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1498	85.2	90.0	90.0
	No	166	9.4	10.0	100.0
	Total	1664	94.6	100.0	
Missing	System	95	5.4		
Total		1759	100.0		

Learning the ratio, proportion and rates of change topic in maths will give me more career opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1051	59.7	63.7	63.7
	No	599	34.1	36.3	100.0
	Total	1650	93.8	100.0	
Missing	System	109	6.2		
Total		1759	100.0		

I will use the ratio, proportion and rates of change topic I learn in maths in everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	639	36.3	38.8	38.8
	No	1010	57.4	61.2	100.0
	Total	1649	93.7	100.0	
Missing	3.00	1	.1		
	4.00	1	.1		
	System	108	6.1		
	Total	110	6.3		
Total		1759	100.0		

Learning the geometry and measures topic in maths will help me to pass my maths exam

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1431	81.4	86.3	86.3
	No	227	12.9	13.7	100.0
	Total	1658	94.3	100.0	
Missing	System	101	5.7		
Total		1759	100.0		

Learning the geometry and measures topic in maths will give me more career opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	990	56.3	60.2	60.2
	No	655	37.2	39.8	100.0
	Total	1645	93.5	100.0	
Missing	System	114	6.5		
Total		1759	100.0		

I will use the geometry and measures topic I learn in maths in everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	490	27.9	29.8	29.8
	No	1153	65.5	70.2	100.0
	Total	1643	93.4	100.0	
Missing	3.00	1	.1		
	System	115	6.5		
	Total	116	6.6		
Total		1759	100.0		

Learning the probability topic in maths will help me to pass my maths exam

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1461	83.1	88.8	88.8
	No	185	10.5	11.2	100.0
	Total	1646	93.6	100.0	
Missing	3.00	1	.1		
	System	112	6.4		
	Total	113	6.4		
Total		1759	100.0		

Learning the probability topic in maths will give me more career opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	959	54.5	58.6	58.6
	No	677	38.5	41.4	100.0
	Total	1636	93.0	100.0	
Missing	3.00	1	.1		
	System	122	6.9		
	Total	123	7.0		
Total		1759	100.0		

I will use the probability topic I learn in maths in everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	537	30.5	32.9	32.9
	No	1093	62.1	67.1	100.0
	Total	1630	92.7	100.0	
Missing	3.00	1	.1		
	4.00	1	.1		
	System	127	7.2		
	Total	129	7.3		
Total		1759	100.0		

Learning the statistics topic in maths will help me to pass my maths exam

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1482	84.3	89.9	89.9
	No	166	9.4	10.1	100.0
	Total	1648	93.7	100.0	
Missing	System	111	6.3		
Total		1759	100.0		

Learning the statistics topic in maths will give me more career opportunities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1168	66.4	71.3	71.3
	No	471	26.8	28.7	100.0
	Total	1639	93.2	100.0	
Missing	System	120	6.8		
Total		1759	100.0		

I will use the statistics topic I learn in maths in everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	654	37.2	40.3	40.3
	No	969	55.1	59.7	100.0
	Total	1623	92.3	100.0	
Missing	4.00	1	.1		
	System	135	7.7		
	Total	136	7.7		
Total		1759	100.0		

Parents Gender

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	105	6.0	27.9	27.9
	Female	271	15.4	72.1	100.0
	Total	376	21.4	100.0	
Missing	System	1383	78.6		
Total		1759	100.0		

Parents speak English as an Additional Language

Do you speak English as an additional language?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	175	9.9	47.0	47.0
	No	197	11.2	53.0	100.0
	Total	372	21.1	100.0	
Missing	System	1387	78.9		
Total		1759	100.0		

Parents Ethnicity

What is your ethnicity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White	195	11.1	55.6	55.6
	South Asian	126	7.2	35.9	91.5
	Black	30	1.7	8.5	100.0
	Total	351	20.0	100.0	
Missing	Chinese	4	.2		
	Mixed	11	.6		
	System	1393	79.2		
	Total	1408	80.0		
Total		1759	100.0		

Parents attitudes – before measure

I did not like maths

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	37	2.1	12.4	12.4
	Agree	63	3.6	21.1	33.6
	Disagree	119	6.8	39.9	73.5
	Strongly Disagree	78	4.4	26.2	99.7
	83.00	1	.1	.3	100.0
	Total	298	16.9	100.0	
Missing	Not sure	57	3.2		
	System	1404	79.8		
	Total	1461	83.1		
Total		1759	100.0		

Maths was hard

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	51	2.9	17.2	17.2
	Agree	142	8.1	47.8	65.0
	Disagree	78	4.4	26.3	91.2
	Strongly Disagree	26	1.5	8.8	100.0
	Total	297	16.9	100.0	
Missing	Not sure	60	3.4		
	System	1402	79.7		
	Total	1462	83.1		
Total		1759	100.0		

Maths was easy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	37	2.1	13.5	13.5
	Agree	81	4.6	29.6	43.1
	Disagree	120	6.8	43.8	86.9
	Strongly Disagree	36	2.0	13.1	100.0
	Total	274	15.6	100.0	
Missing	Not sure	82	4.7		
	System	1403	79.8		
	Total	1485	84.4		
Total		1759	100.0		

I was good at maths

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	81	4.6	27.1	27.1
	Agree	142	8.1	47.5	74.6
	Disagree	58	3.3	19.4	94.0
	Strongly Disagree	18	1.0	6.0	100.0
	Total	299	17.0	100.0	
Missing	Not sure	59	3.4		
	System	1401	79.6		
	Total	1460	83.0		
Total		1759	100.0		

I did maths at home

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	92	5.2	28.0	28.0
	Agree	159	9.0	48.5	76.5
	Disagree	58	3.3	17.7	94.2
	Strongly Disagree	19	1.1	5.8	100.0
	Total	328	18.6	100.0	
Missing	Not sure	35	2.0		
	System	1396	79.4		
	Total	1431	81.4		
Total		1759	100.0		

GCSE maths is relevant to everyday life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	97	5.5	34.5	34.5
	Agree	142	8.1	50.5	85.1
	Disagree	29	1.6	10.3	95.4
	Strongly Disagree	13	.7	4.6	100.0
	Total	281	16.0	100.0	
Missing	Not sure	83	4.7		
	System	1395	79.3		
	Total	1478	84.0		
Total		1759	100.0		

Maths was boring

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	18	1.0	7.0	7.0
	Agree	47	2.7	18.3	25.3
	Disagree	133	7.6	51.8	77.0
	Strongly Disagree	59	3.4	23.0	100.0
	Total	257	14.6	100.0	
Missing	Not sure	96	5.5		
	System	1406	79.9		
	Total	1502	85.4		
Total		1759	100.0		

I liked my maths teacher

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	102	5.8	33.2	33.2
	Agree	156	8.9	50.8	84.0
	Disagree	20	1.1	6.5	90.6
	Strongly Disagree	29	1.6	9.4	100.0
	Total	307	17.5	100.0	
Missing	Not sure	55	3.1		
	System	1397	79.4		
	Total	1452	82.5		
Total		1759	100.0		

Appendix E: Bivariate analysis

Appendix E.1: In-School Value

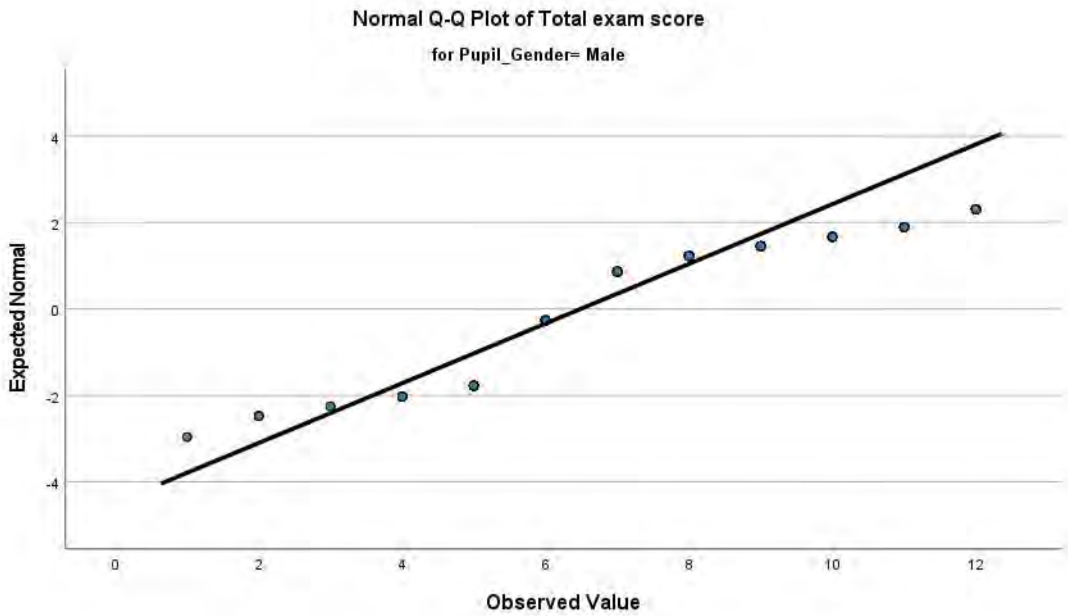
Gender parametric assumptions

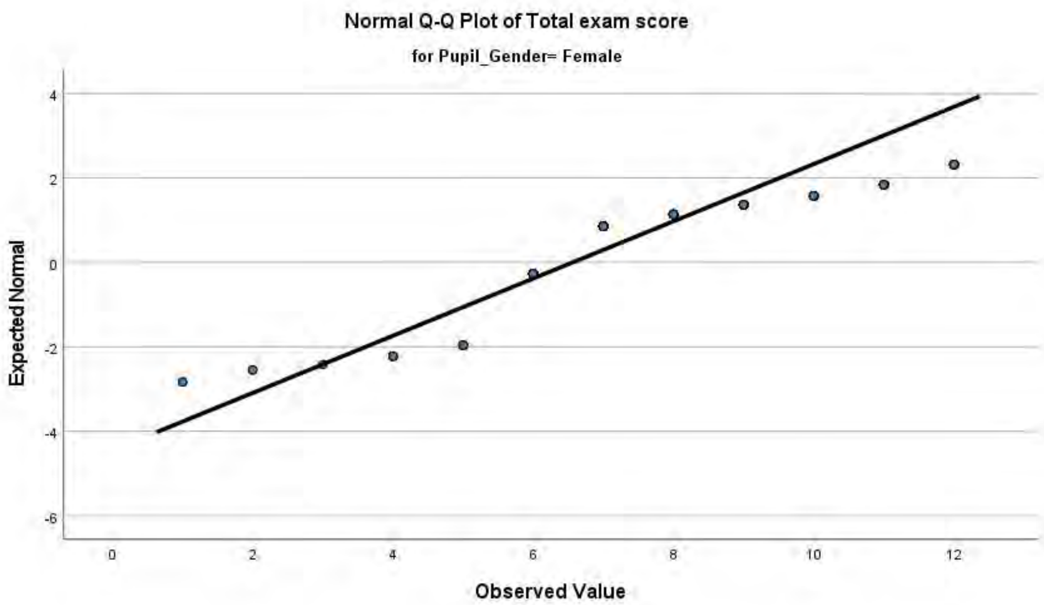
Descriptives

	What is your gender?			Statistic	Std. Error
Total exam score	Male	Mean		6.4894	.04602
		95% Confidence Interval for Mean	Lower Bound	6.3991	
			Upper Bound	6.5797	
		5% Trimmed Mean		6.3687	
		Median		6.0000	
		Variance		2.094	
		Std. Deviation		1.44716	
		Minimum		1.00	
		Maximum		12.00	
		Range		11.00	
		Interquartile Range		1.00	
		Skewness		1.616	.078
		Kurtosis		5.360	.155
	Female	Mean		6.5603	.05838
		95% Confidence Interval for Mean	Lower Bound	6.4456	
			Upper Bound	6.6749	
		5% Trimmed Mean		6.4020	
		Median		6.0000	
		Variance		2.178	
		Std. Deviation		1.47573	
		Minimum		1.00	
		Maximum		12.00	
		Range		11.00	
		Interquartile Range		.00	
		Skewness		1.772	.097
		Kurtosis		4.763	.193

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Total exam score	Based on Mean	.902	1	1626	.342
	Based on Median	.001	1	1626	.976
	Based on Median and with adjusted df	.001	1	1623.476	.976
	Based on trimmed mean	.260	1	1626	.610





Gender and In-School Value Output

Group Statistics

	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
Exam Total	Male	989	5.2447	1.45888	.04639
	Female	639	5.2707	1.46333	.05789

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p			Lower	Upper
Exam Total	Equal variances assumed	.069	.793	-.351	1626	.363	.725	-.02604	.07413	-.17145	.11936
	Equal variances not assumed			-.351	1358.707	.363	.726	-.02604	.07418	-.17157	.11948

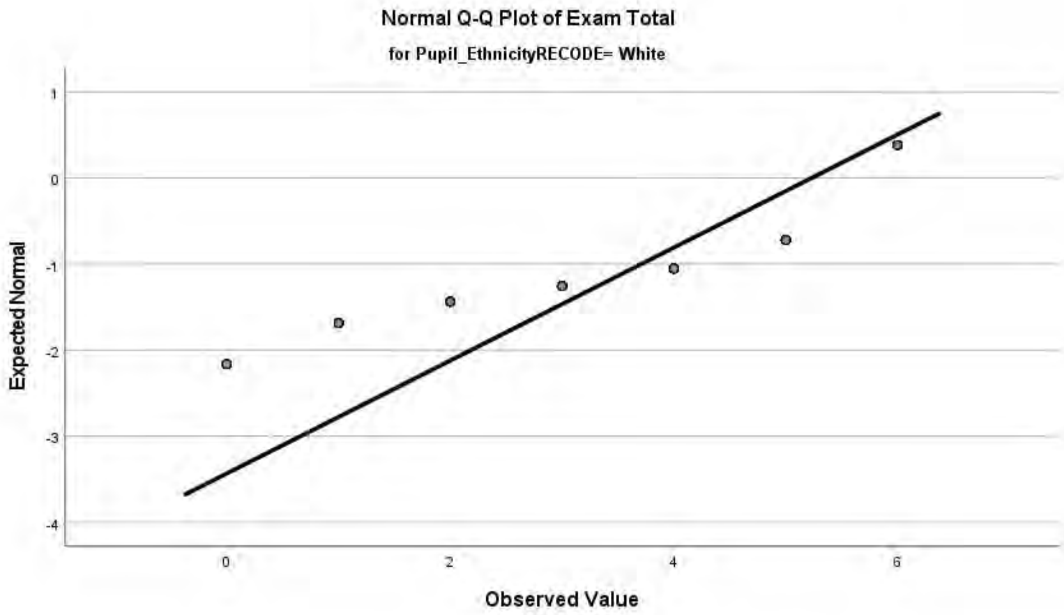
Ethnicity parametric assumptions

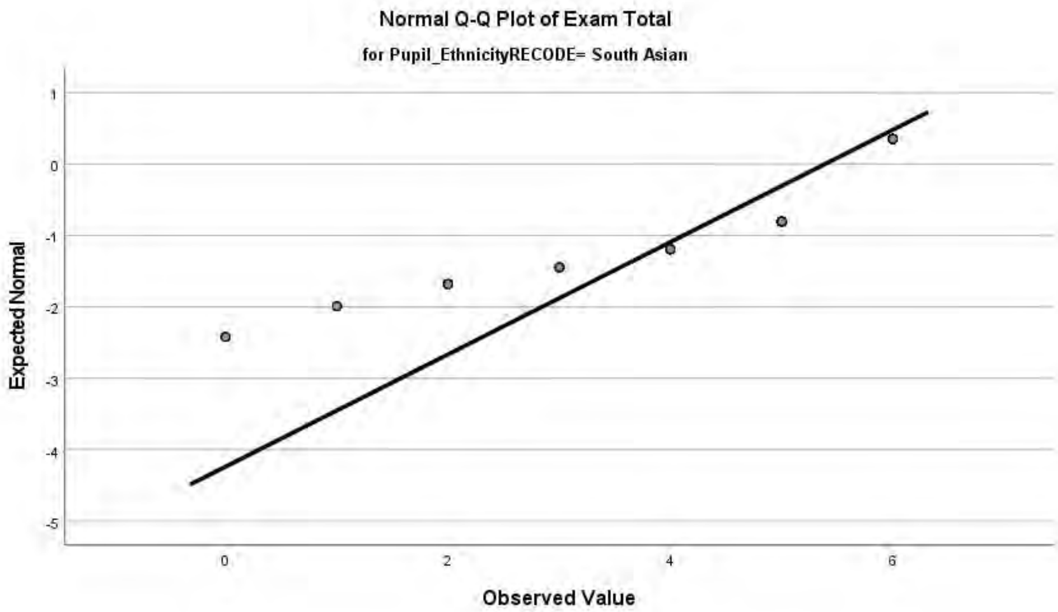
Descriptives

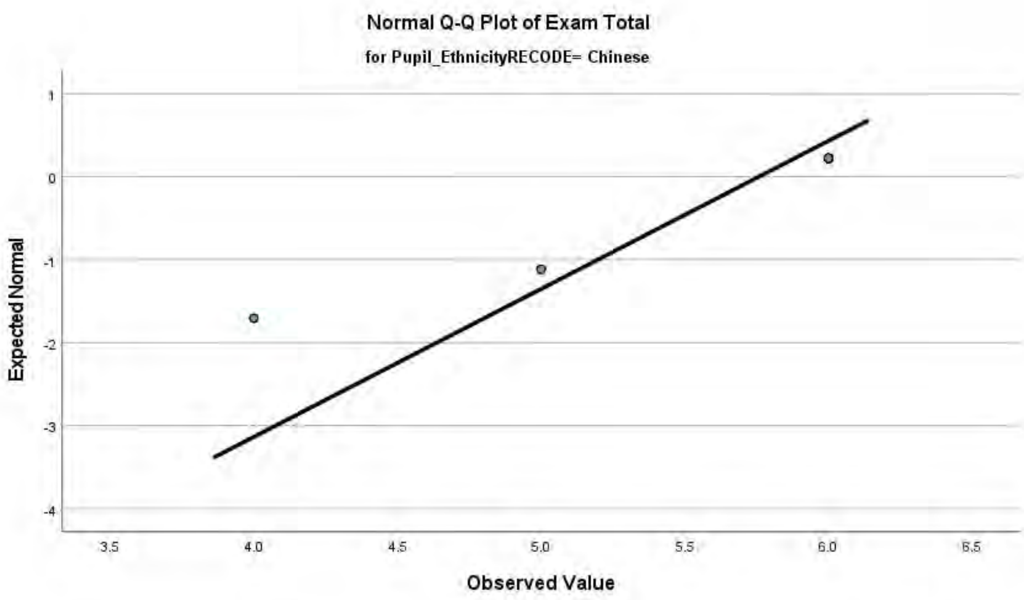
	What is your ethnicity?			Statistic	Std. Error
Exam Total	White	Mean		5.2297	.05341
		95% Confidence Interval for Mean	Lower Bound	5.1249	
			Upper Bound	5.3346	
		5% Trimmed Mean		5.4547	
		Median		6.0000	
		Variance		2.322	
		Std. Deviation		1.52391	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.177	.086
		Kurtosis		3.792	.171
	South Asian	Mean		5.3889	.05998
		95% Confidence Interval for Mean	Lower Bound	5.2710	
			Upper Bound	5.5068	
		5% Trimmed Mean		5.5926	
		Median		6.0000	
		Variance		1.619	
		Std. Deviation		1.27241	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.480	.115
		Kurtosis		5.829	.230
	Chinese	Mean		5.7576	.09761
		95% Confidence Interval for Mean	Lower Bound	5.5588	
			Upper Bound	5.9564	
		5% Trimmed Mean		5.8418	
		Median		6.0000	
		Variance		.314	
		Std. Deviation		.56071	
		Minimum		4.00	
		Maximum		6.00	
		Range		2.00	
		Interquartile Range		.00	
		Skewness		-2.305	.409
		Kurtosis		4.514	.798
	Black	Mean		5.1905	.11007
		95% Confidence Interval for Mean	Lower Bound	4.9732	
			Upper Bound	5.4078	
		5% Trimmed Mean		5.3889	
		Median		6.0000	
		Variance		2.035	
		Std. Deviation		1.42666	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-1.894	.187
		Kurtosis		2.883	.373
	Mixed	Mean		5.0120	.18502
		95% Confidence Interval for Mean	Lower Bound	4.6440	
			Upper Bound	5.3801	
		5% Trimmed Mean		5.2202	
		Median		6.0000	
		Variance		2.841	
		Std. Deviation		1.68562	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-1.835	.264
		Kurtosis		2.352	.523

Test of Homogeneity of Variance

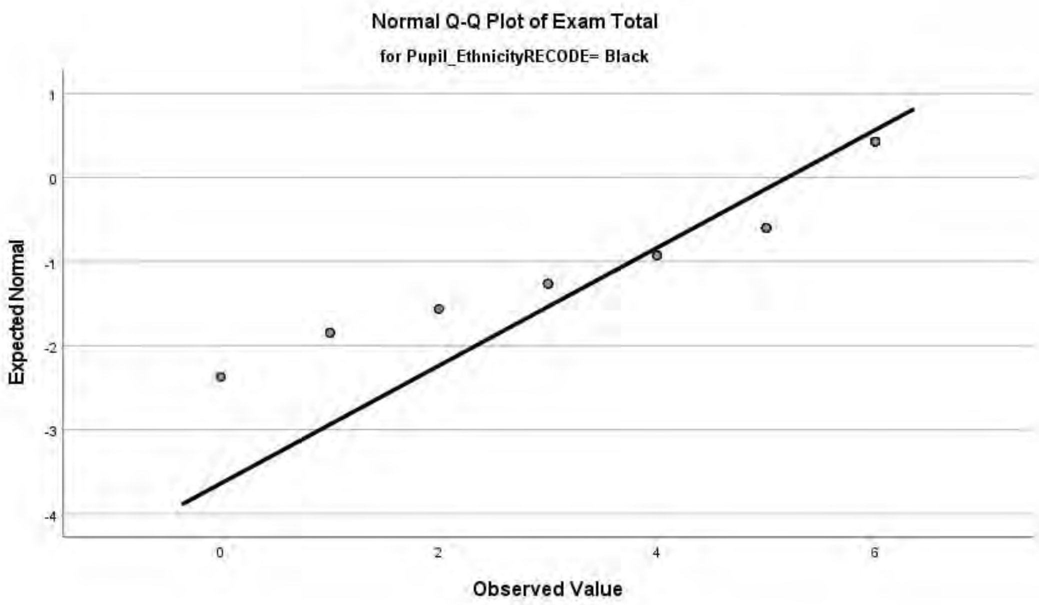
		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	7.016	4	1543	<.001
	Based on Median	2.667	4	1543	.031
	Based on Median and with adjusted df	2.667	4	1478.172	.031
	Based on trimmed mean	5.945	4	1543	<.001



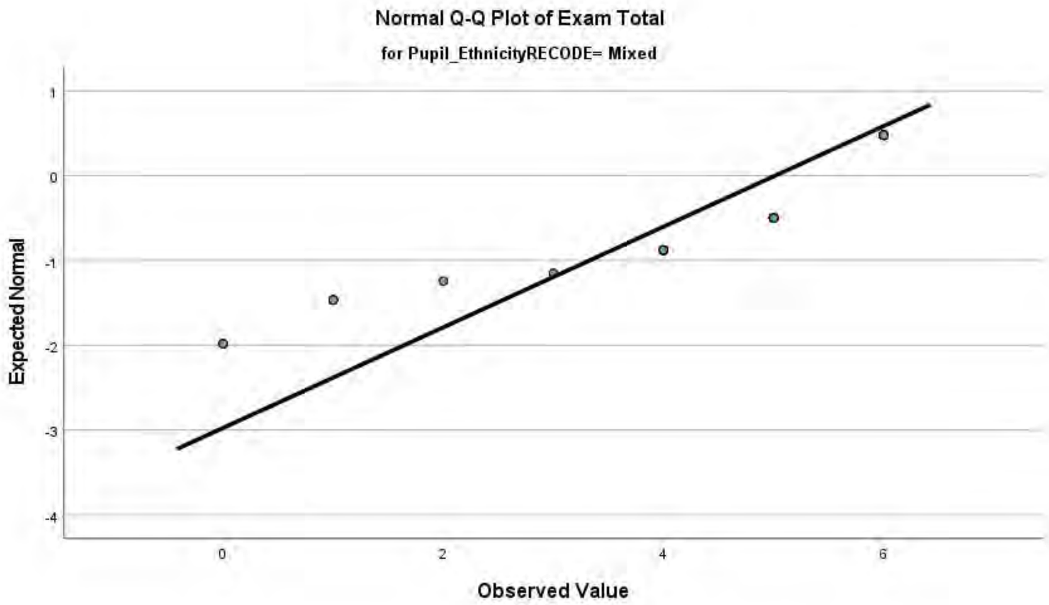




Normal Q-Q Plot of Exam Total
for Pupil_EthnicityRECODE= Chinese
Expected Normal
Observed Value



Normal Q-Q Plot of Exam Total
for Pupil_EthnicityRECODE= Black
Expected Normal
Observed Value



Ethnicity output

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Exam Total is the same across categories of What is your ethnicity?.	Independent-Samples Kruskal-Wallis Test	.082	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Independent-Samples Kruskal-Wallis Test Summary

Total N	1548
Test Statistic	8.272[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.082

a. The test statistic is adjusted for ties.

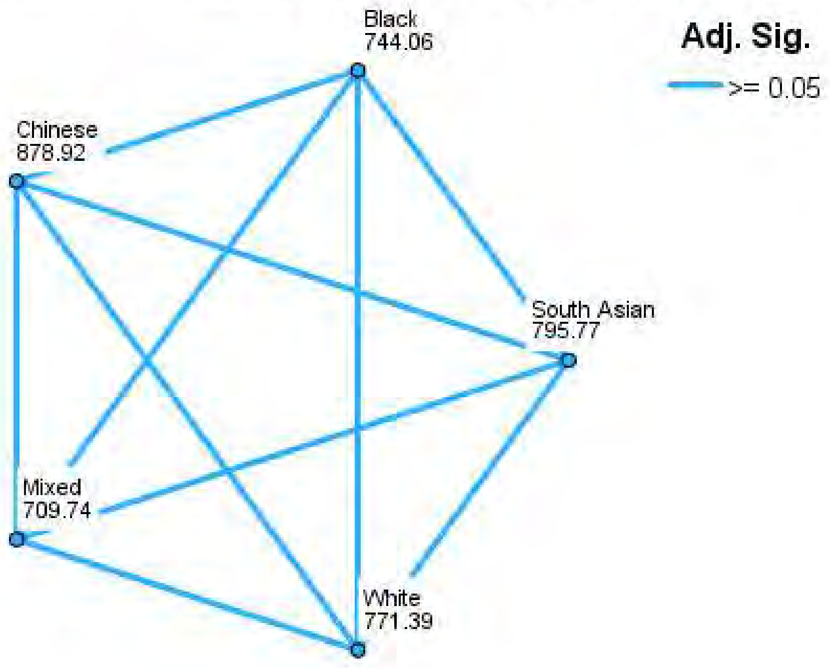
Pairwise Comparisons of What is your ethnicity?

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Mixed-Black	34.316	48.369	.709	.478	1.000
Mixed-White	61.652	41.540	1.484	.138	1.000
Mixed-South Asian	86.032	43.067	1.998	.046	.458
Mixed-Chinese	169.183	74.192	2.280	.023	.226
Black-White	27.336	30.550	.895	.371	1.000
Black-South Asian	51.717	32.596	1.587	.113	1.000
Black-Chinese	134.868	68.645	1.965	.049	.494
White-South Asian	-24.381	21.178	-1.151	.250	1.000
White-Chinese	-107.532	64.017	-1.680	.093	.930
South Asian-Chinese	-83.151	65.018	-1.279	.201	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Pairwise Comparisons of What is your ethnicity?



Each node shows the sample average rank of What is your ethnicity?.

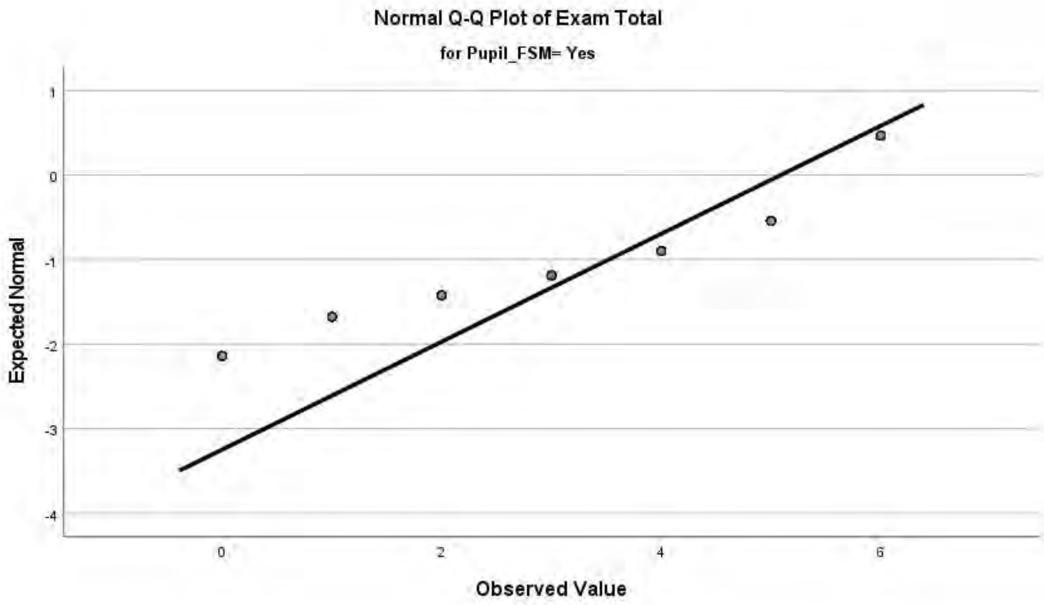
Free School Meal parametric assumptions

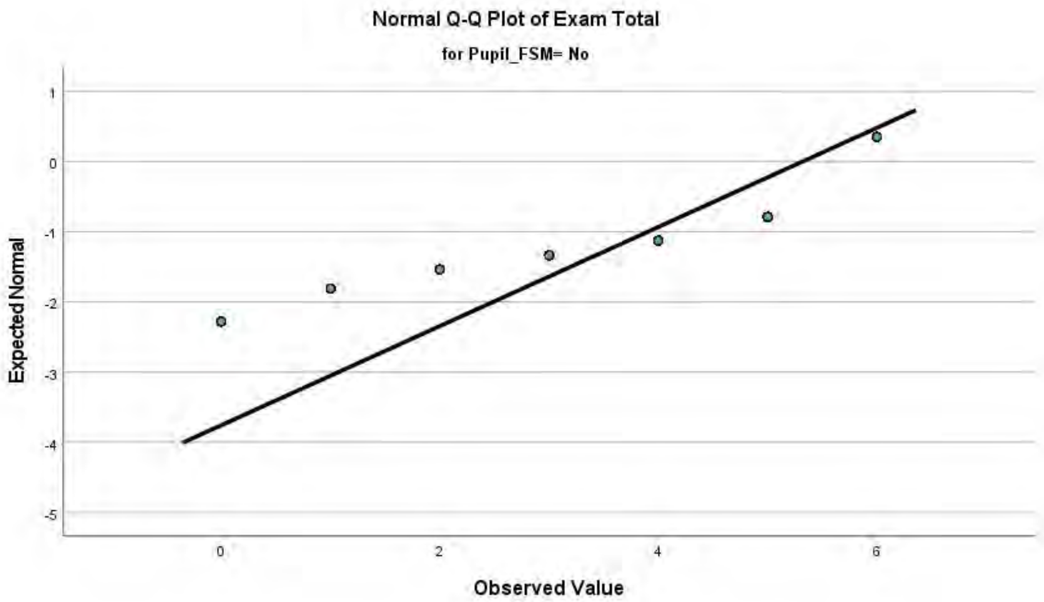
Descriptives

	Do you have free school meals?			Statistic	Std. Error
Exam Total	Yes	Mean		5.0864	.06866
		95% Confidence Interval for Mean	Lower Bound	4.9515	
			Upper Bound	5.2213	
		5% Trimmed Mean		5.2968	
		Median		6.0000	
		Variance		2.456	
		Std. Deviation		1.56716	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-1.859	.107
		Kurtosis		2.597	.214
	No	Mean		5.3194	.04184
		95% Confidence Interval for Mean	Lower Bound	5.2373	
			Upper Bound	5.4015	
		5% Trimmed Mean		5.5435	
		Median		6.0000	
		Variance		2.006	
		Std. Deviation		1.41641	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.352	.072
		Kurtosis		4.769	.144

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	11.160	1	1665	<.001
	Based on Median	9.058	1	1665	.003
	Based on Median and with adjusted df	9.058	1	1649.448	.003
	Based on trimmed mean	14.054	1	1665	<.001





Free School Meal Output

Ranks

	Do you have free school meals?	N	Mean Rank	Sum of Ranks
Exam Total	Yes	521	782.56	407715.50
	No	1146	857.38	982562.50
	Total	1667		

Test Statistics[a]

	Exam Total
Mann-Whitney U	271734.500
Wilcoxon W	407715.500
Z	-3.628
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Do you have free school meals?

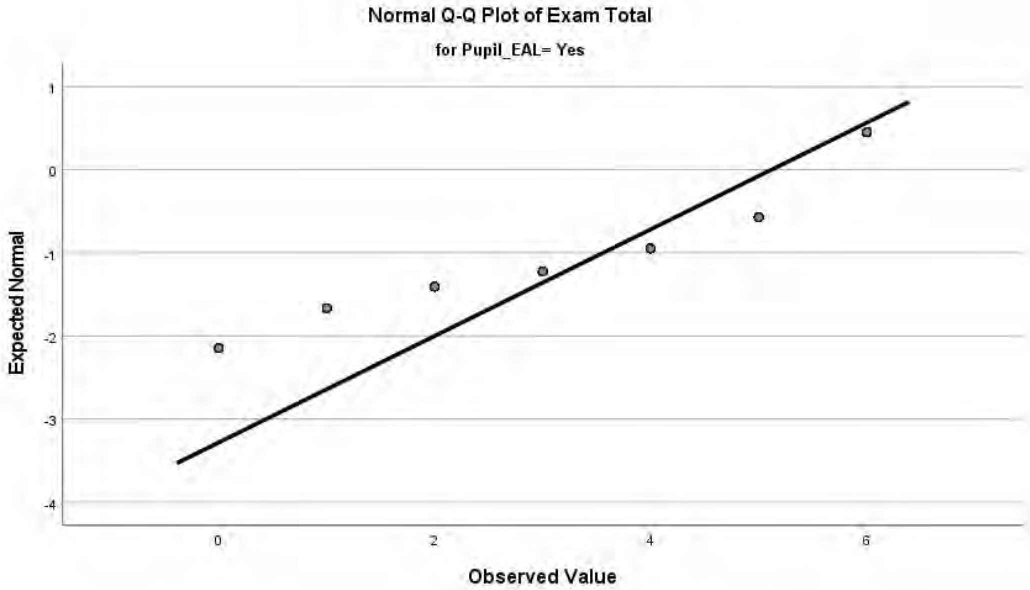
English as an additional language parametric assumption

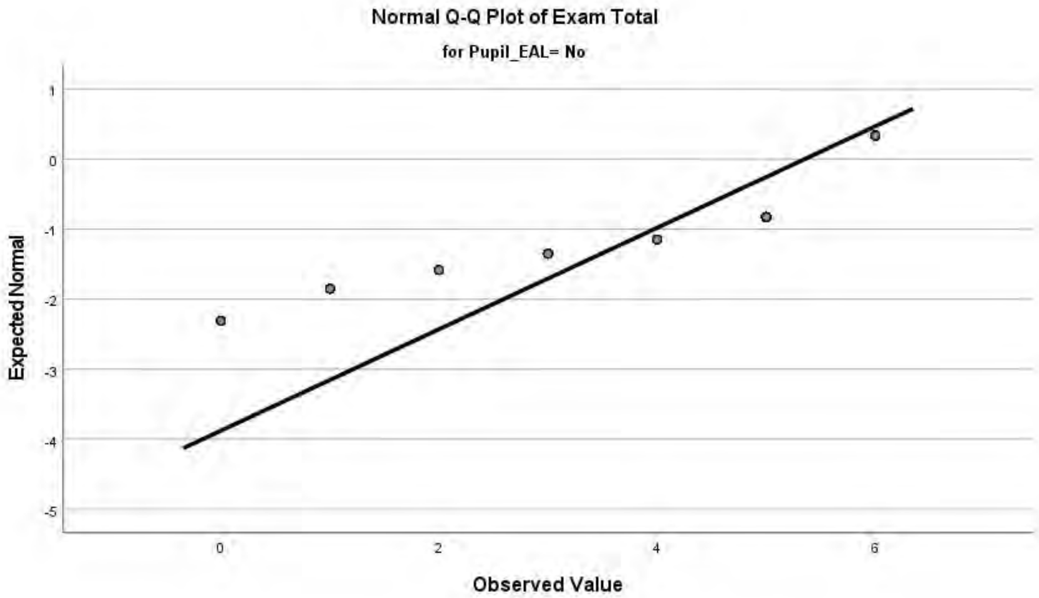
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
Exam Total	Yes	Mean		5.1168	.05816
		95% Confidence Interval for Mean	Lower Bound	5.0026	
			Upper Bound	5.2310	
		5% Trimmed Mean		5.3305	
		Median		6.0000	
		Variance		2.432	
		Std. Deviation		1.55949	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-1.943	.091
		Kurtosis		2.899	.182
	No	Mean		5.3526	.04479
		95% Confidence Interval for Mean	Lower Bound	5.2647	
			Upper Bound	5.4405	
		5% Trimmed Mean		5.5731	
		Median		6.0000	
		Variance		1.906	
		Std. Deviation		1.38061	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.420	.079
		Kurtosis		5.154	.159

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	14.794	1	1667	<.001
	Based on Median	10.670	1	1667	.001
	Based on Median and with adjusted df	10.670	1	1642.505	.001
	Based on trimmed mean	17.844	1	1667	<.001





English as an additional language output

Ranks

	Do you speak English as an additional language?	N	Mean Rank	Sum of Ranks
Exam Total	Yes	719	792.29	569659.00
	No	950	867.32	823956.00
	Total	1669		

Test Statistics[a]

	Exam Total
Mann-Whitney U	310819.000
Wilcoxon W	569659.000
Z	-3.886
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Do you speak English as an additional language?

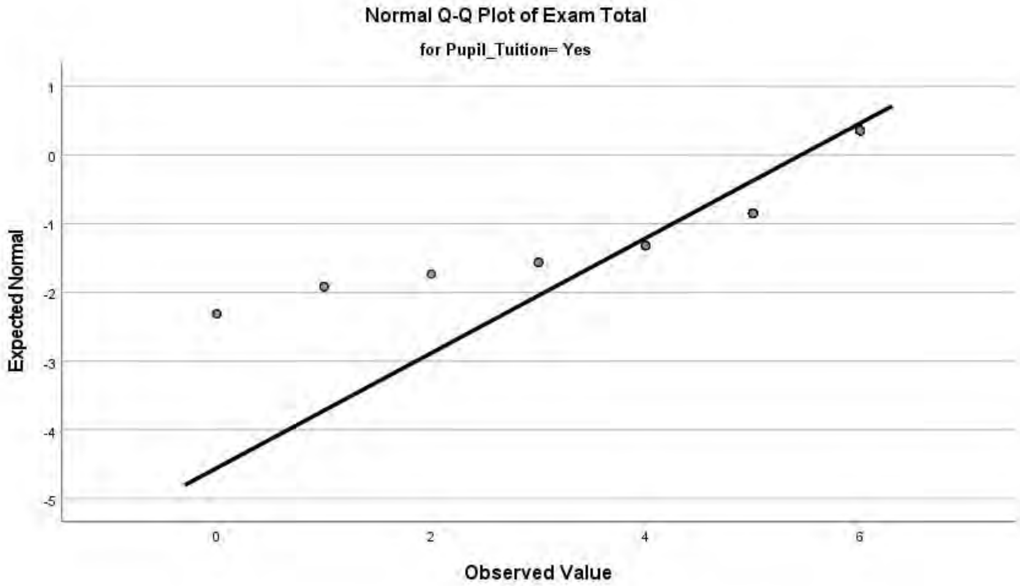
Extra maths tuition parametric assumptions

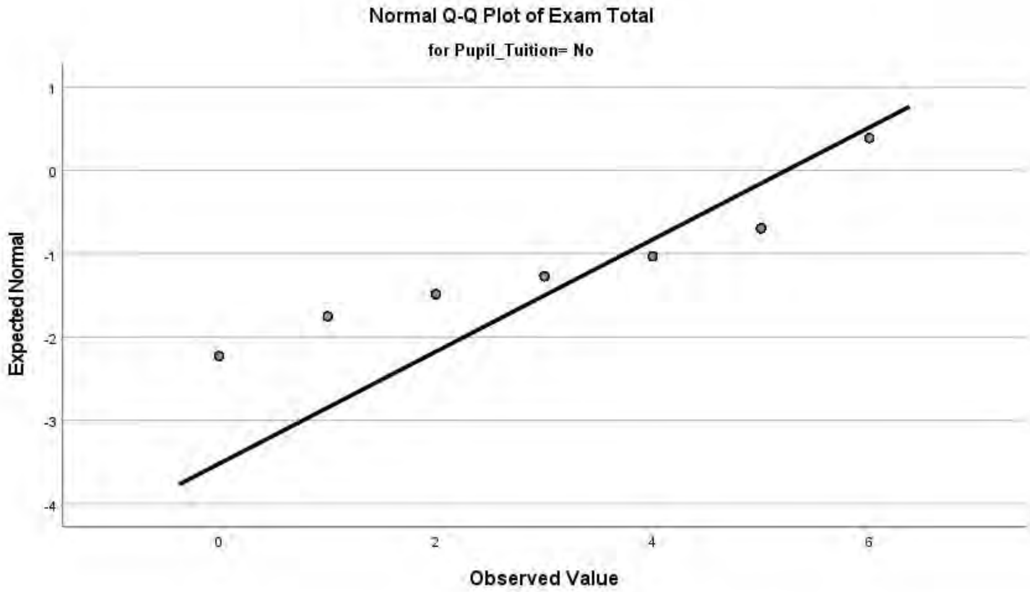
Descriptives

	Do you have extra maths tuition outside of school?			Statistic	Std. Error
Exam Total	Yes	Mean		5.4476	.10007
		95% Confidence Interval for Mean	Lower Bound	5.2497	
			Upper Bound	5.6454	
		5% Trimmed Mean		5.6538	
		Median		6.0000	
		Variance		1.432	
		Std. Deviation		1.19670	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.875	.203
		Kurtosis		8.602	.403
	No	Mean		5.2305	.03793
		95% Confidence Interval for Mean	Lower Bound	5.1561	
			Upper Bound	5.3049	
		5% Trimmed Mean		5.4510	
		Median		6.0000	
		Variance		2.210	
		Std. Deviation		1.48662	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.134	.062
		Kurtosis		3.712	.125

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	9.540	1	1677	.002
	Based on Median	2.875	1	1677	.090
	Based on Median and with adjusted df	2.875	1	1660.063	.090
	Based on trimmed mean	8.115	1	1677	.004





Extra maths tuition output

Ranks

	Do you have extra maths tuition outside of school?	N	Mean Rank	Sum of Ranks
Exam Total	Yes	143	872.54	124773.00
	No	1536	836.97	1285587.00
	Total	1679		

Test Statistics[a]

	Exam Total
Mann-Whitney U	105171.000
Wilcoxon W	1285587.000
Z	-1.035
Asymp. Sig. (2-tailed)	.301

a. Grouping Variable: Do you have extra maths tuition outside of school?

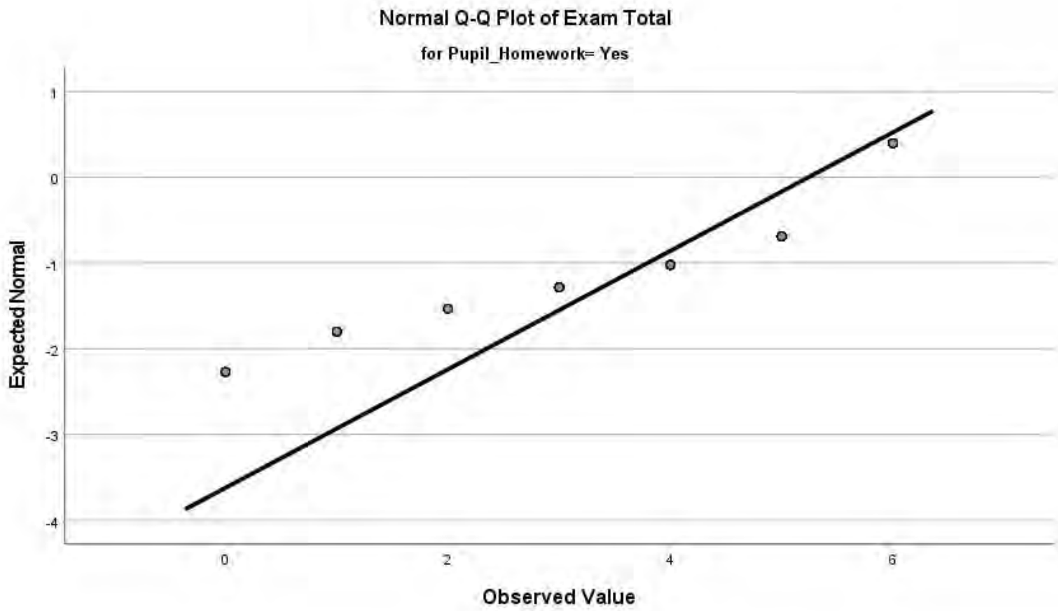
Parents help with homework parametric assumptions

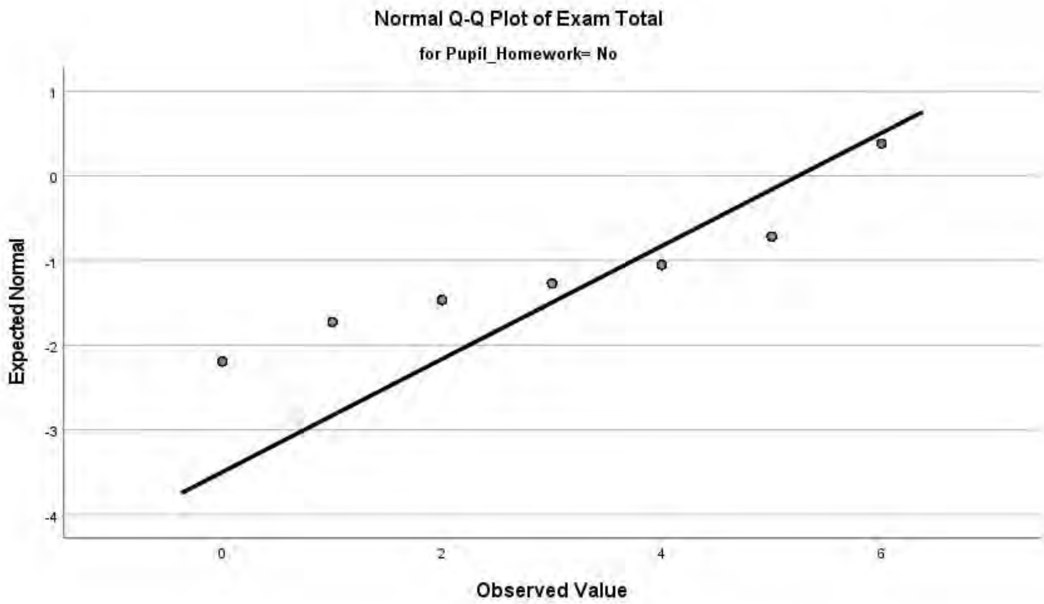
Descriptives

	Do your parents help you with your maths homework?			Statistic	Std. Error
Exam Total	Yes	Mean		5.2401	.06987
		95% Confidence Interval for Mean	Lower Bound	5.1028	
			Upper Bound	5.3774	
		5% Trimmed Mean		5.4556	
		Median		6.0000	
		Variance		2.094	
		Std. Deviation		1.44710	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.121	.118
		Kurtosis		3.767	.235
	No	Mean		5.2388	.04271
		95% Confidence Interval for Mean	Lower Bound	5.1550	
			Upper Bound	5.3226	
		5% Trimmed Mean		5.4627	
		Median		6.0000	
		Variance		2.245	
		Std. Deviation		1.49845	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.178	.070
		Kurtosis		3.863	.139

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	,117	1	1658	,733
	Based on Median	,000	1	1658	,988
	Based on Median and with adjusted df	,000	1	1656,509	,988
	Based on trimmed mean	,031	1	1658	,860





Parents help with homework output

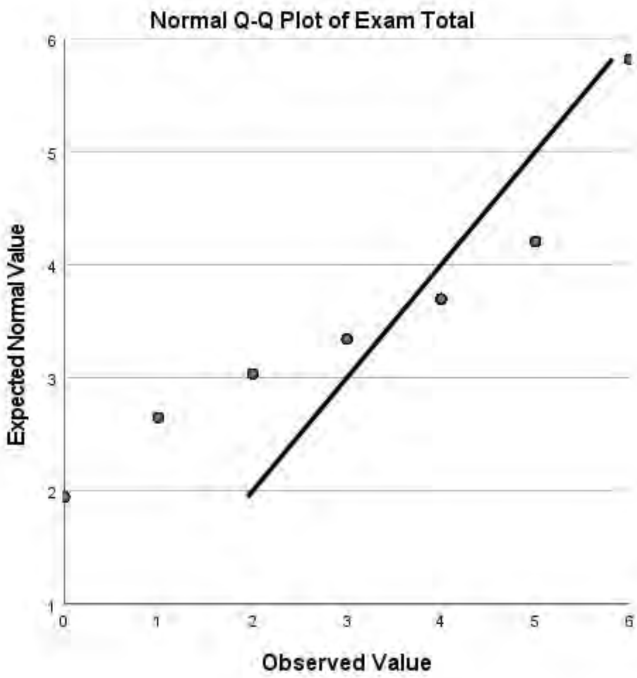
Group Statistics

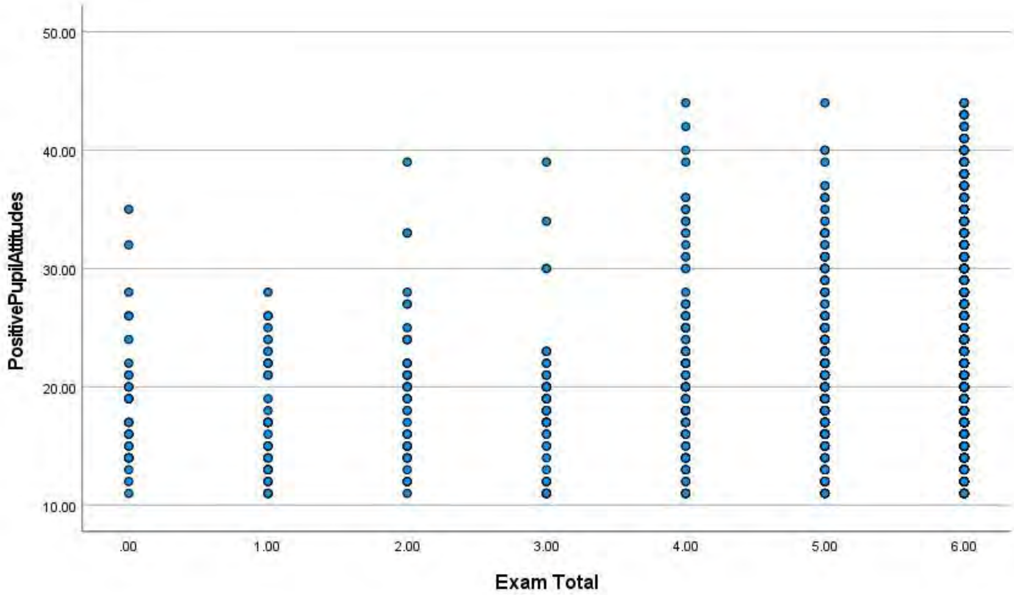
	Do your parents help you with your maths homework?	N	Mean	Std. Deviation	Std. Error Mean
Exam Total	Yes	429	5.2401	1.44710	.06987
	No	1231	5.2388	1.49845	.04271

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Exam Total	Equal variances assumed	.117	.733	.015	1658	.494	.988	.00126	.08328	-.16208	.16460
	Equal variances not assumed			.015	770.202	.494	.988	.00126	.08189	-.15948	.16201

Pupils attitudes parametric assumptions





Pupils’ attitudes output

Correlations

			Exam Total	PositivePupilAttitudes
Spearman's rho	Exam Total	Correlation Coefficient	1.000	.178**
		Sig. (2-tailed)	.	<.001
		N	1695	1603
	PositivePupilAttitudes	Correlation Coefficient	.178**	1.000
		Sig. (2-tailed)	<.001	.
		N	1603	1605

**. Correlation is significant at the 0.01 level (2-tailed).

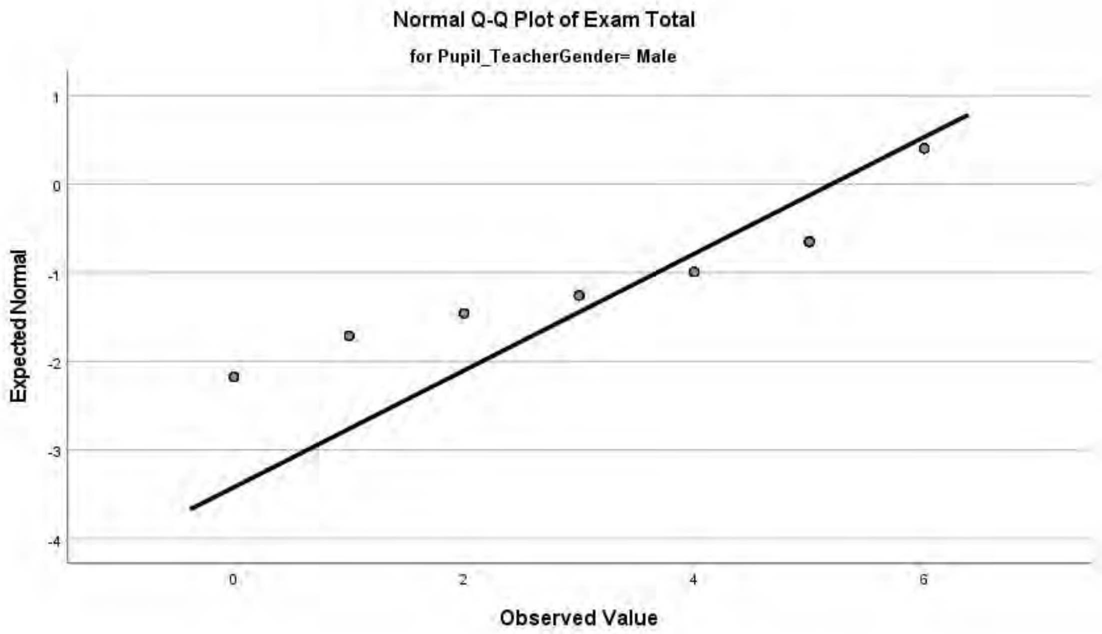
Teacher gender parametric assumptions

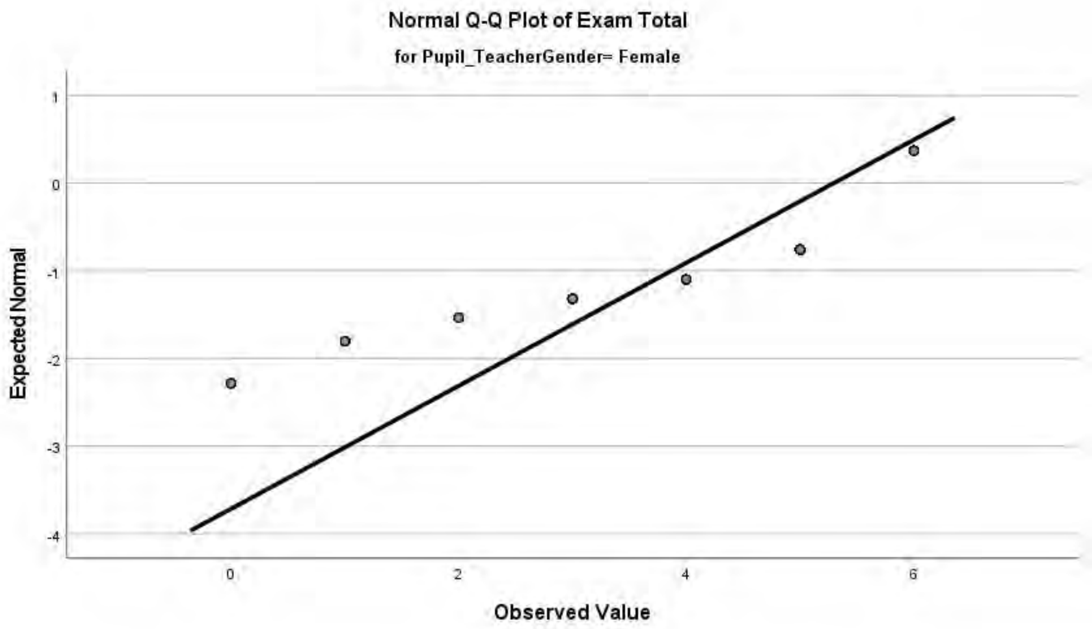
Descriptives

	Is your maths teacher male or female?			Statistic	Std. Error
Exam Total	Male	Mean		5.1906	.06001
		95% Confidence Interval for Mean	Lower Bound	5.0728	
			Upper Bound	5.3085	
		5% Trimmed Mean		5.4097	
		Median		6.0000	
		Variance		2.305	
		Std. Deviation		1.51814	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.061	.097
		Kurtosis		3.412	.193
	Female	Mean		5.2946	.04552
		95% Confidence Interval for Mean	Lower Bound	5.2053	
			Upper Bound	5.3839	
		5% Trimmed Mean		5.5166	
		Median		6.0000	
		Variance		2.033	
		Std. Deviation		1.42566	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.283	.078
		Kurtosis		4.454	.156

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	4.013	1	1619	.045
	Based on Median	1.957	1	1619	.162
	Based on Median and with adjusted df	1.957	1	1612.764	.162
	Based on trimmed mean	4.184	1	1619	.041





Teacher gender output

Ranks

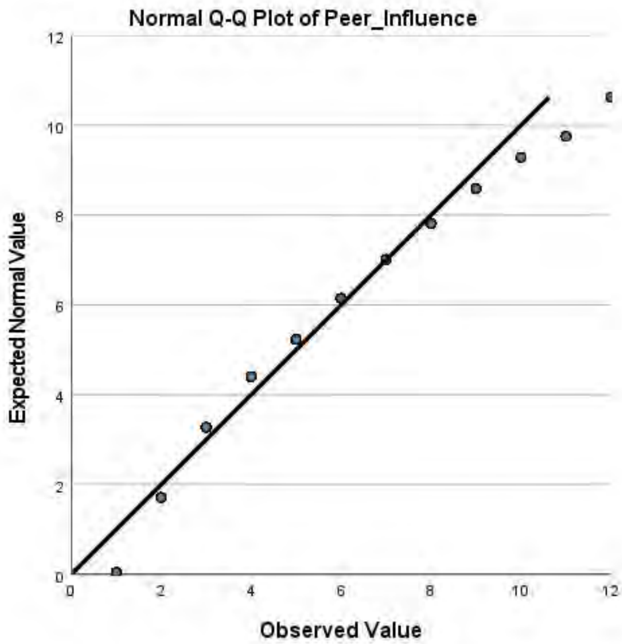
	Is your maths teacher male or female?	N	Mean Rank	Sum of Ranks
Exam Total	Male	640	795.18	508913.00
	Female	981	821.32	805718.00
	Total	1621		

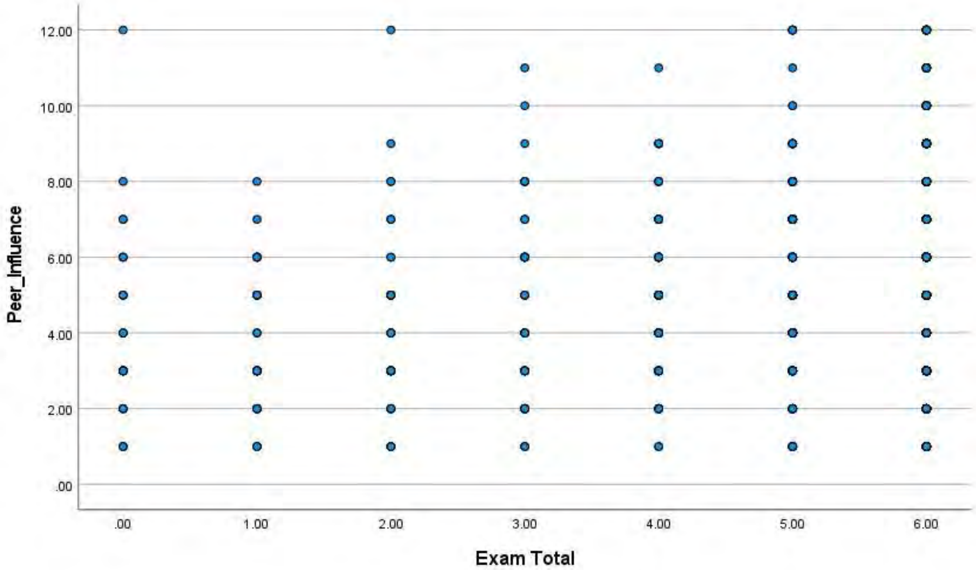
Test Statistics[a]

	Exam Total
Mann-Whitney U	303793.000
Wilcoxon W	508913.000
Z	-1.360
Asymp. Sig. (2-tailed)	.174

a. Grouping Variable: Is your maths teacher male or female?

Peer attitudes parametric assumptions





Peet attitudes output

Correlations

			Peer_Influence	Exam Total
Spearman's rho	Peer_Influence	Correlation Coefficient	1.000	.121**
		Sig. (2-tailed)	.	<.001
		N	1545	1543
	Exam Total	Correlation Coefficient	.121**	1.000
		Sig. (2-tailed)	<.001	.
		N	1543	1695

**. Correlation is significant at the 0.01 level (2-tailed).

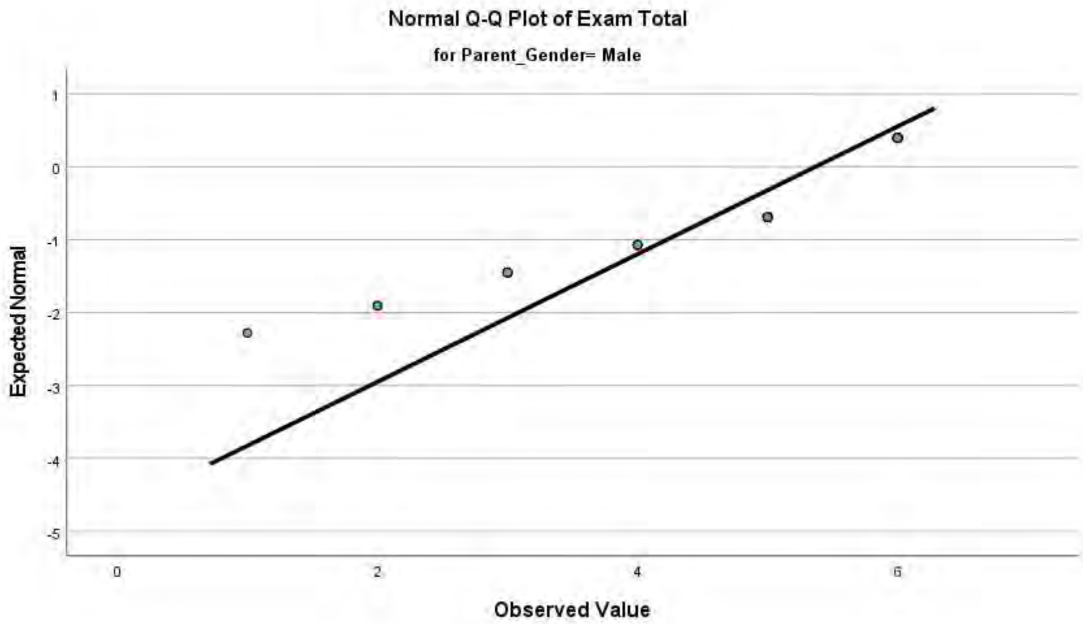
Parent gender parametric assumptions

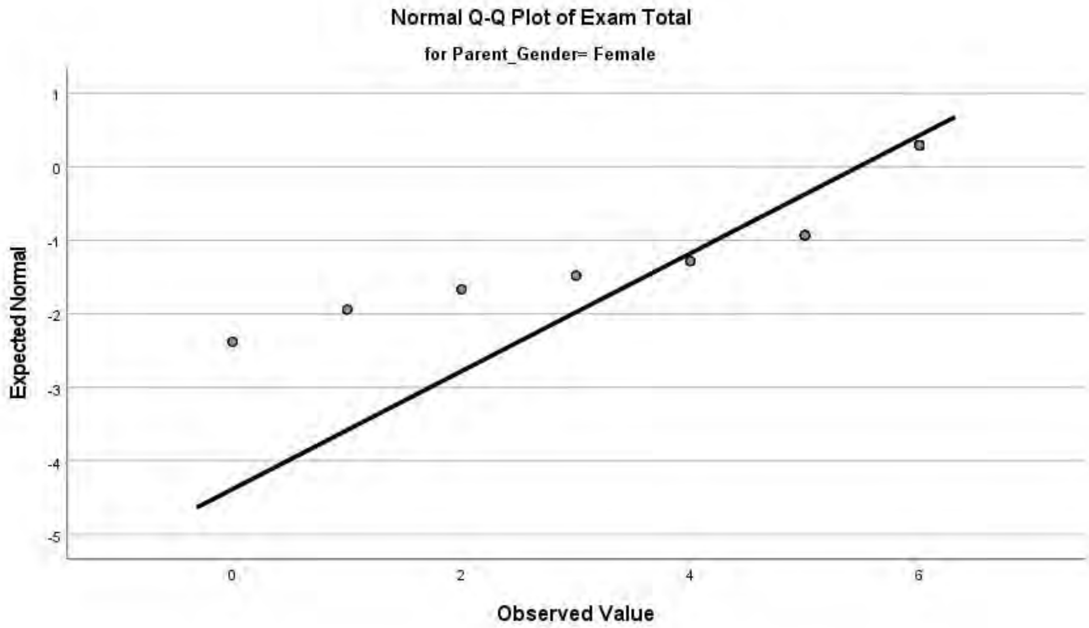
Descriptives

	What is your gender?			Statistic	Std. Error
Exam Total	Male	Mean		5.3678	.12247
		95% Confidence Interval for Mean	Lower Bound	5.1243	
			Upper Bound	5.6113	
		5% Trimmed Mean		5.5153	
		Median		6.0000	
		Variance		1.305	
		Std. Deviation		1.14237	
		Minimum		1.00	
		Maximum		6.00	
		Range		5.00	
		Interquartile Range		1.00	
		Skewness		-1.917	.258
		Kurtosis		3.047	.511
	Female	Mean		5.4672	.08246
		95% Confidence Interval for Mean	Lower Bound	5.3048	
			Upper Bound	5.6297	
		5% Trimmed Mean		5.6836	
		Median		6.0000	
		Variance		1.557	
		Std. Deviation		1.24781	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		.00	
		Skewness		-2.787	.161
		Kurtosis		7.429	.320

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	.225	1	314	.635
	Based on Median	.419	1	314	.518
	Based on Median and with adjusted df	.419	1	312.219	.518
	Based on trimmed mean	.824	1	314	.365





Parent gender output

Group Statistics

	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
Exam Total	Male	87	5.3678	1.14237	.12247
	Female	229	5.4672	1.24781	.08246

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Exam Total	Equal variances assumed	.225	.635	-.647	314	.259	.518	-.09943	.15363	-.40170	.20284
	Equal variances not assumed			-.673	168.571	.251	.502	-.09943	.14765	-.39091	.19204

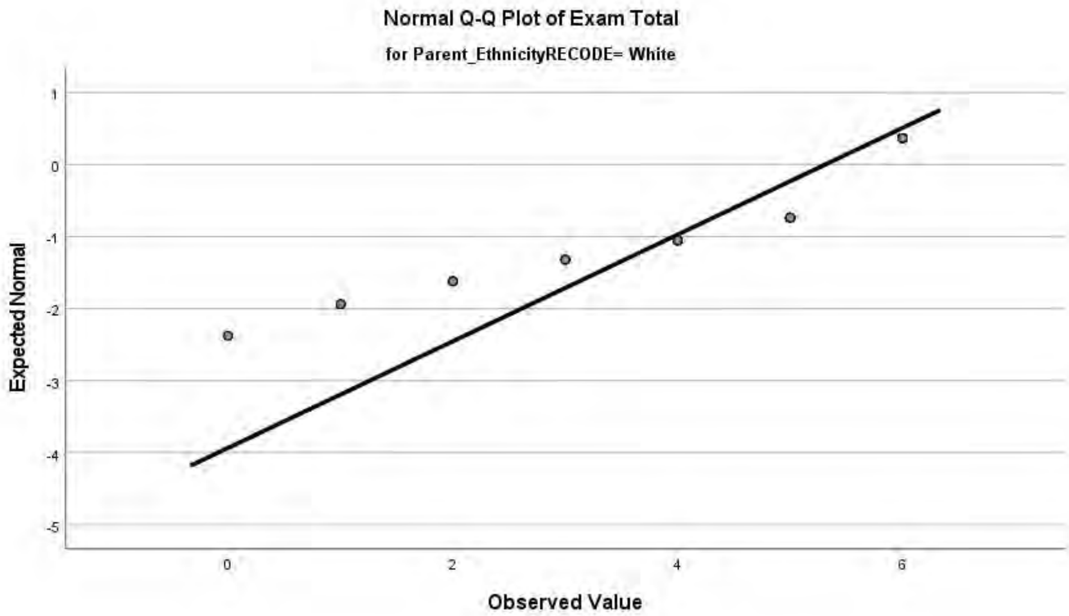
Parent ethnicity parametric assumptions

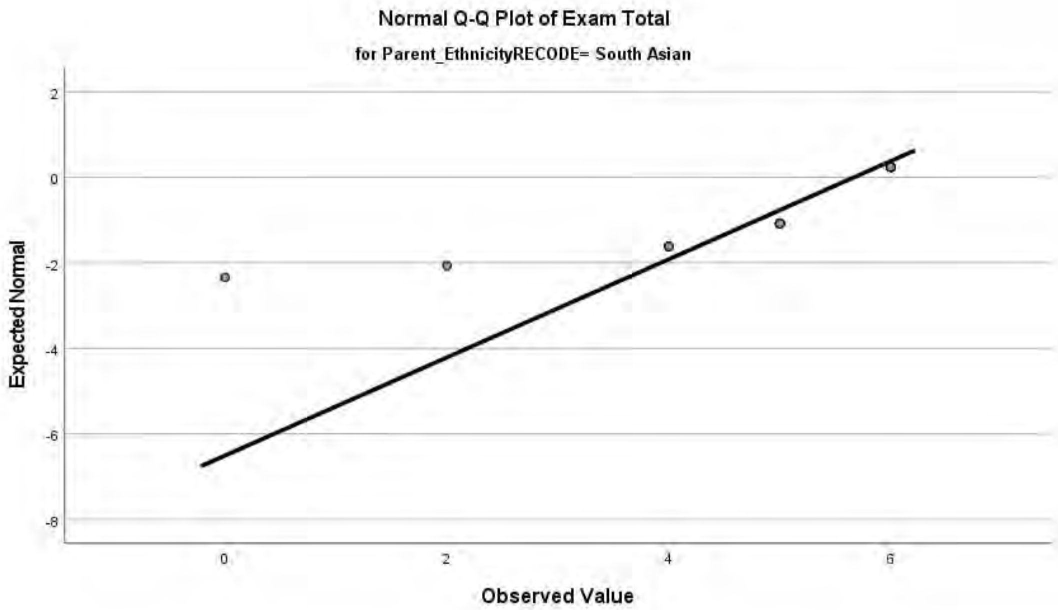
Descriptives

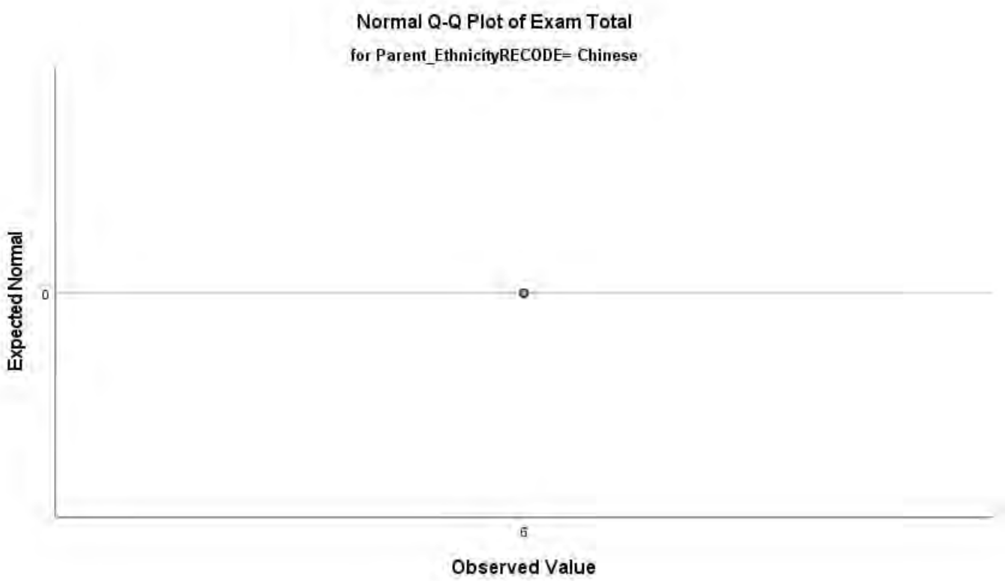
	What is your ethnicity?			Statistic	Std. Error
Exam Total	White	Mean		5.3118	.10362
		95% Confidence Interval for Mean	Lower Bound	5.1072	
			Upper Bound	5.5163	
		5% Trimmed Mean		5.5098	
		Median		6.0000	
		Variance		1.825	
		Std. Deviation		1.35104	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.172	.186
		Kurtosis		4.099	.370
	South Asian	Mean		5.6667	.08627
		95% Confidence Interval for Mean	Lower Bound	5.4955	
			Upper Bound	5.8378	
		5% Trimmed Mean		5.8061	
		Median		6.0000	
		Variance		.759	
		Std. Deviation		.87125	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		.00	
		Skewness		-3.964	.239
		Kurtosis		19.913	.474
	Chinese	Mean		6.0000	.00000
		95% Confidence Interval for Mean	Lower Bound	6.0000	
			Upper Bound	6.0000	
		5% Trimmed Mean		6.0000	
		Median		6.0000	
		Variance		.000	
		Std. Deviation		.00000	
		Minimum		6.00	
		Maximum		6.00	
		Range		.00	
		Interquartile Range		.00	
		Skewness		.	.
		Kurtosis		.	.
	Black	Mean		5.5769	.19353
		95% Confidence Interval for Mean	Lower Bound	5.1783	
			Upper Bound	5.9755	
		5% Trimmed Mean		5.7393	
		Median		6.0000	
		Variance		.974	
		Std. Deviation		.98684	
		Minimum		2.00	
		Maximum		6.00	
		Range		4.00	
		Interquartile Range		.25	
		Skewness		-2.801	.456
		Kurtosis		7.807	.887
	Mixed	Mean		5.3750	.37500
		95% Confidence Interval for Mean	Lower Bound	4.4883	
			Upper Bound	6.2617	
		5% Trimmed Mean		5.4722	
		Median		6.0000	
		Variance		1.125	
		Std. Deviation		1.06066	
		Minimum		3.00	
		Maximum		6.00	
		Range		3.00	
		Interquartile Range		1.00	
		Skewness		-1.960	.752
		Kurtosis		3.937	1.481

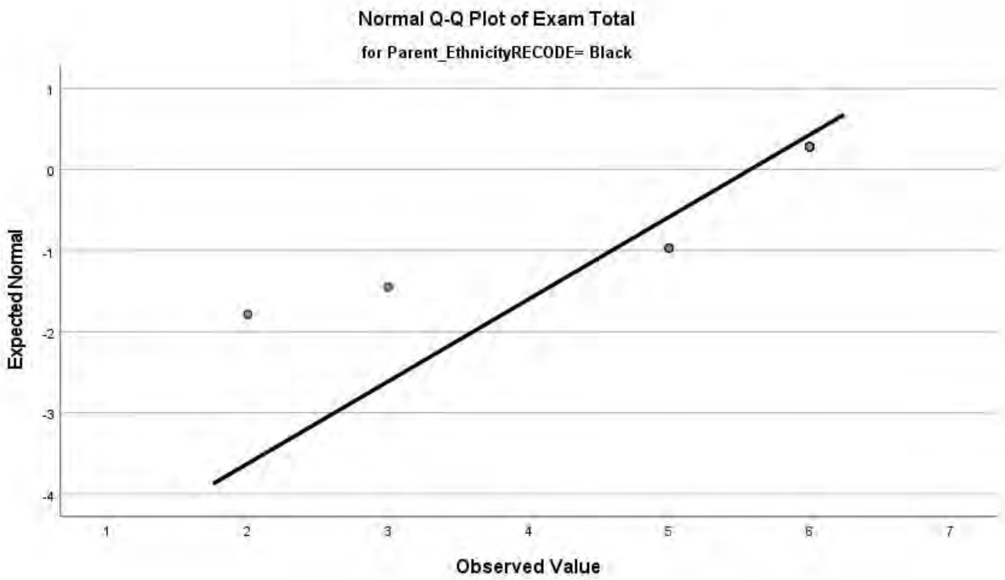
Test of Homogeneity of Variance

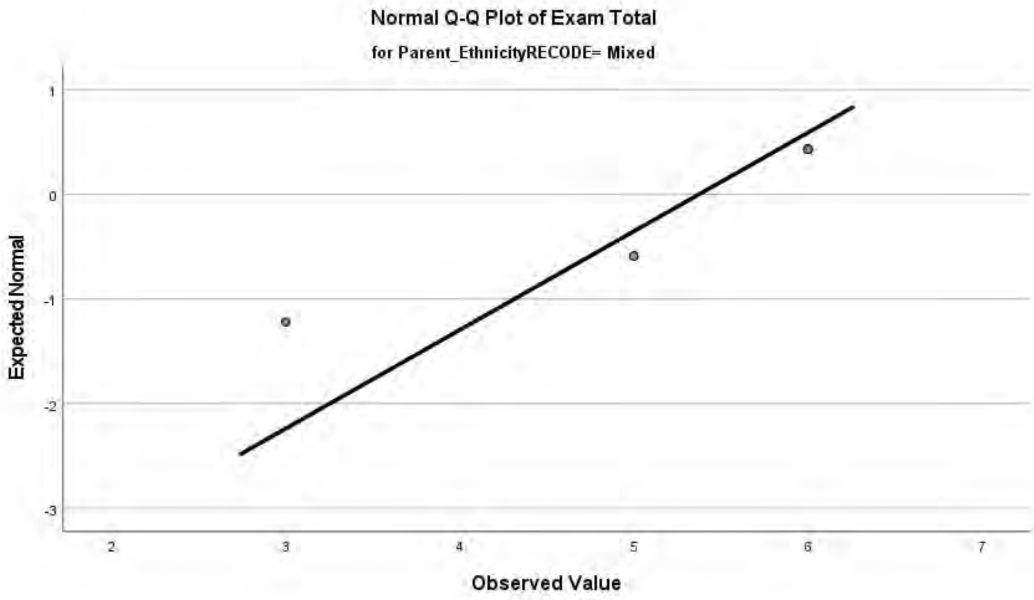
		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	5.483	4	304	<.001
	Based on Median	1.708	4	304	.148
	Based on Median and with adjusted df	1.708	4	266.420	.148
	Based on trimmed mean	4.379	4	304	.002






Normal Q-Q Plot of Exam Total
for Parent_EthnicityRECODE= Chinese
Expected Normal
0
6
Observed Value


Normal Q-Q Plot of Exam Total
for Parent_EthnicityRECODE= Black
Expected Normal
1
0
-1
-2
-3
-4
1
2
3
4
5
6
7
Observed Value



Parent ethnicity output

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Exam Total is the same across categories of What is your ethnicity?.	Independent-Samples Kruskal-Wallis Test	.139	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Independent-Samples Kruskal-Wallis Test Summary

Total N	298
Test Statistic	3.941[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	.139

a. The test statistic is adjusted for ties.

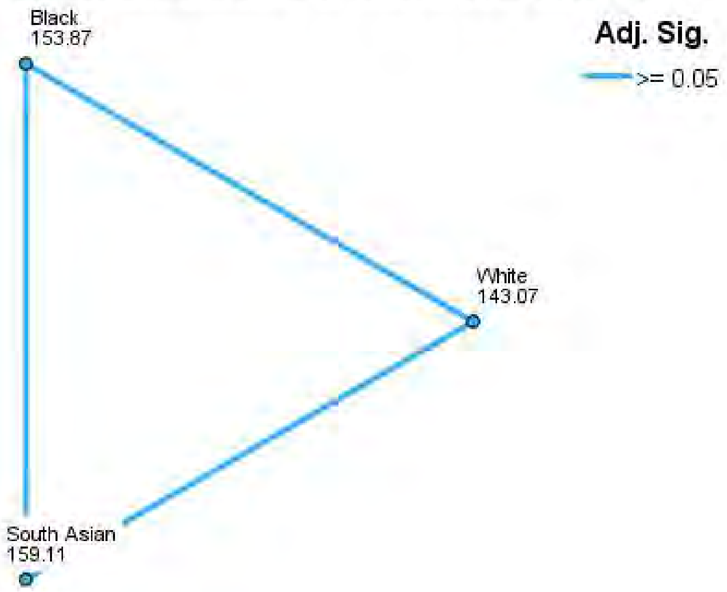
Pairwise Comparisons of What is your ethnicity?

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
White-Black	-10.798	13.807	-.782	.434	1.000
White-South Asian	-16.040	8.212	-1.953	.051	.152
Black-South Asian	5.242	14.405	.364	.716	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Pairwise Comparisons of What is your ethnicity?



Each node shows the sample average rank of What is your ethnicity?.

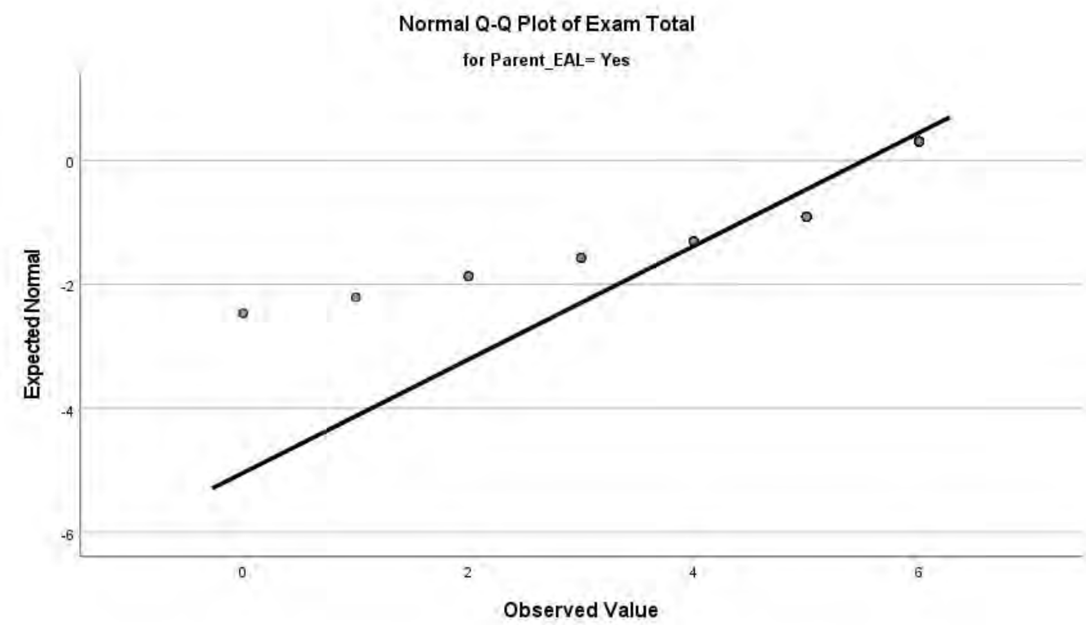
Parent English as an Additional Language parametric assumptions

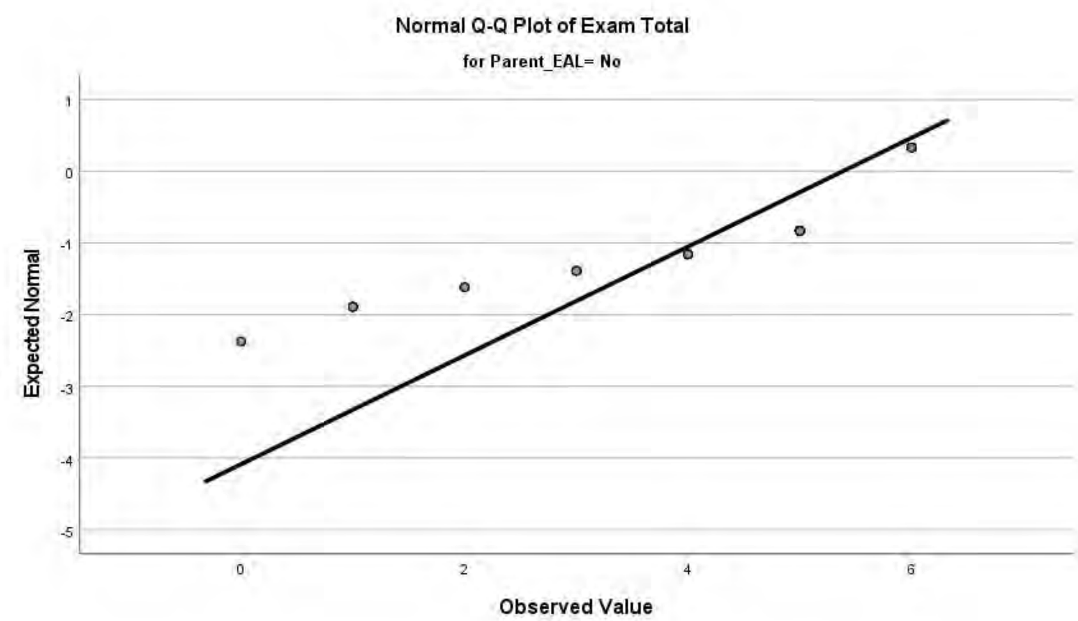
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
Exam Total	Yes	Mean		5.5103	.09082
		95% Confidence Interval for Mean	Lower Bound	5.3308	
			Upper Bound	5.6899	
		5% Trimmed Mean		5.6916	
		Median		6.0000	
		Variance		1.196	
		Std. Deviation		1.09365	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		.00	
		Skewness		-2.740	.201
		Kurtosis		7.797	.400
	No	Mean		5.3846	.10141
		95% Confidence Interval for Mean	Lower Bound	5.1844	
			Upper Bound	5.5848	
		5% Trimmed Mean		5.5976	
		Median		6.0000	
		Variance		1.738	
		Std. Deviation		1.31837	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		1.00	
		Skewness		-2.459	.187
		Kurtosis		5.509	.371

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Exam Total	Based on Mean	2.795	1	312	.096
	Based on Median	.829	1	312	.363
	Based on Median and with adjusted df	.829	1	302.039	.363
	Based on trimmed mean	2.018	1	312	.156





Parent English as an Additional Language output

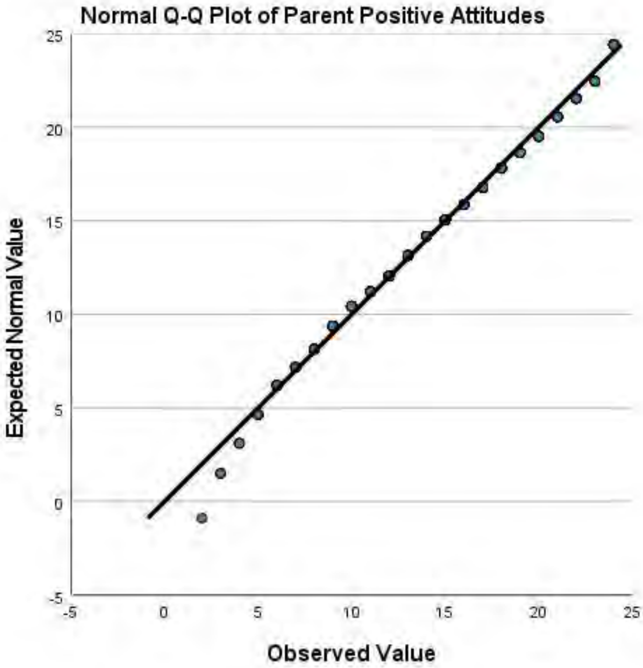
Group Statistics

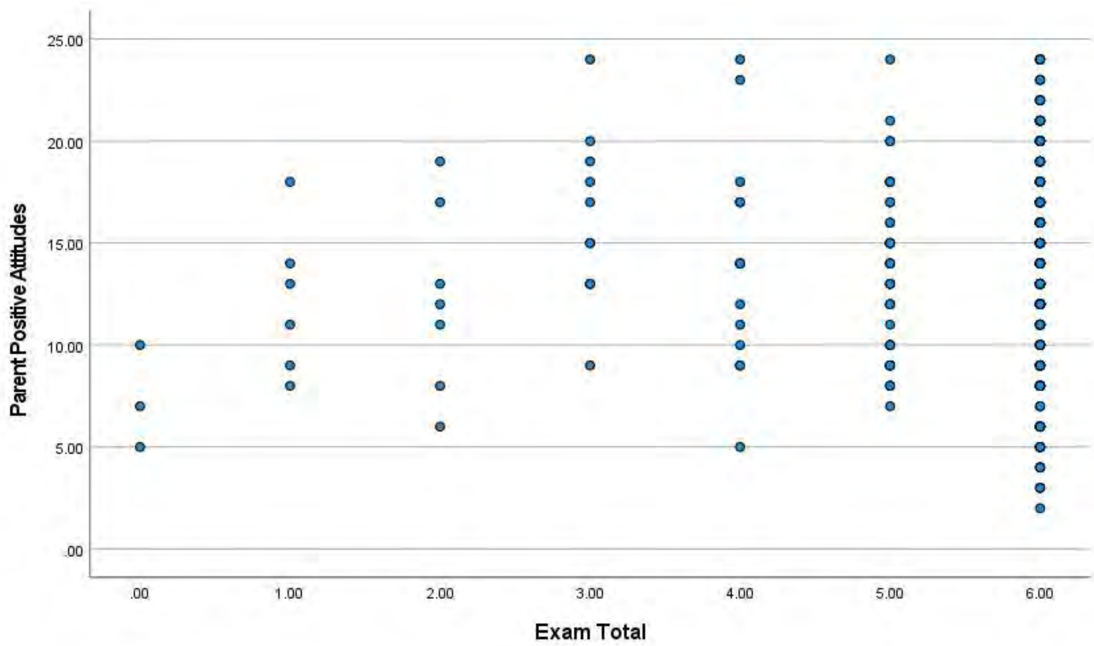
	Do you speak English as an additional language?	N	Mean	Std. Deviation	Std. Error Mean
Exam Total	Yes	145	5.5103	1.09365	.09082
	No	169	5.3846	1.31837	.10141

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Exam Total	Equal variances assumed	2.795	.096	.911	312	.182	.363	.12573	.13808	-.14596	.39741
	Equal variances not assumed			.924	311.660	.178	.356	.12573	.13614	-.14213	.39359

Parent attitudes parametric assumptions





Parents attitudes output

Correlations

			Exam Total	Parent Positive Attitudes
Spearman's rho	Exam Total	Correlation Coefficient	1.000	.031
		Sig. (2-tailed)	.	.585
		N	1695	310
	Parent Positive Attitudes	Correlation Coefficient	.031	1.000
		Sig. (2-tailed)	.585	.
		N	310	368

Appendix E.2: Out-School Value

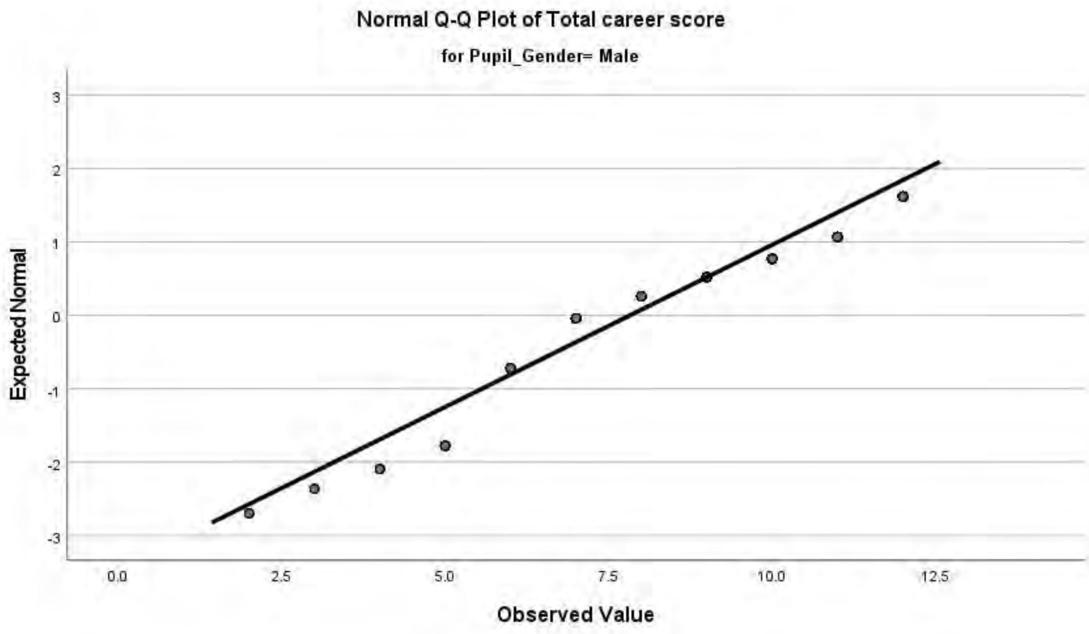
Gender parametric assumptions

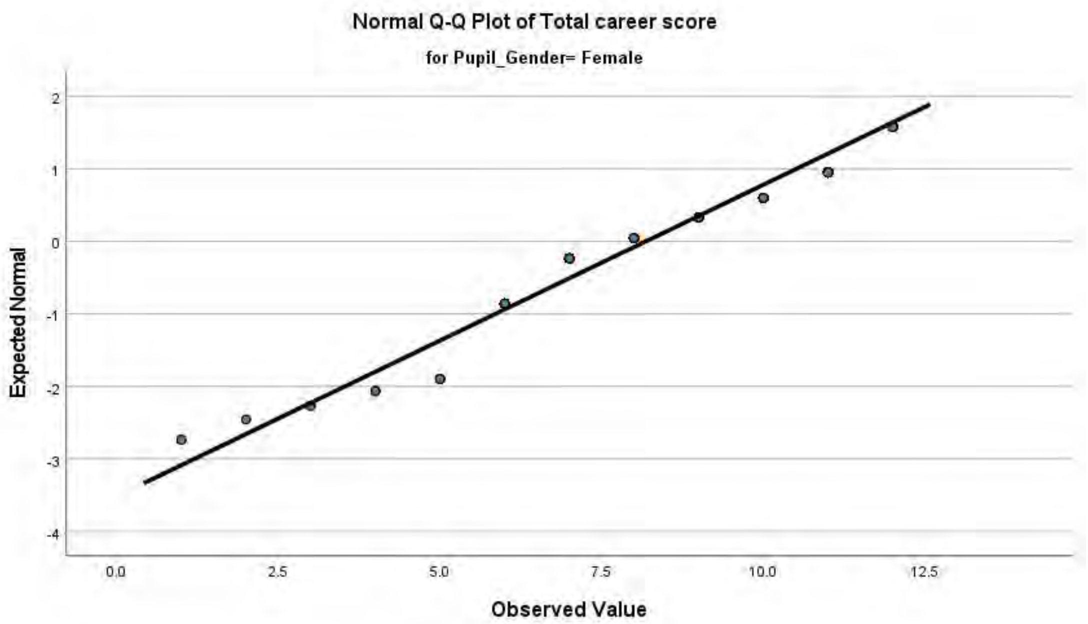
Descriptives

	What is your gender?			Statistic	Std. Error
Total career score	Male	Mean		7.8229	.07206
		95% Confidence Interval for Mean	Lower Bound	7.6815	
			Upper Bound	7.9643	
		5% Trimmed Mean		7.7937	
		Median		7.0000	
		Variance		5.131	
		Std. Deviation		2.26511	
		Minimum		2.00	
		Maximum		12.00	
		Range		10.00	
		Interquartile Range		4.00	
		Skewness		.481	.078
		Kurtosis		-.722	.155
	Female	Mean		8.1834	.09218
		95% Confidence Interval for Mean	Lower Bound	8.0024	
			Upper Bound	8.3644	
		5% Trimmed Mean		8.1850	
		Median		8.0000	
		Variance		5.422	
		Std. Deviation		2.32843	
		Minimum		1.00	
		Maximum		12.00	
		Range		11.00	
		Interquartile Range		4.00	
		Skewness		.125	.097
		Kurtosis		-.767	.193

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Total career score	Based on Mean	1.686	1	1624	.194
	Based on Median	3.125	1	1624	.077
	Based on Median and with adjusted df	3.125	1	1560.103	.077
	Based on trimmed mean	1.814	1	1624	.178





Gender output

Group Statistics

	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Male	988	3.8765	2.15577	.06858
	Female	638	3.5345	2.20202	.08718

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Career Total	Equal variances assumed	3.044	.081	3.098	1624	<.001	.002	.34204	.11042	.12546	.55861
	Equal variances not assumed			3.084	1338.576	.001	.002	.34204	.11092	.12443	.55964

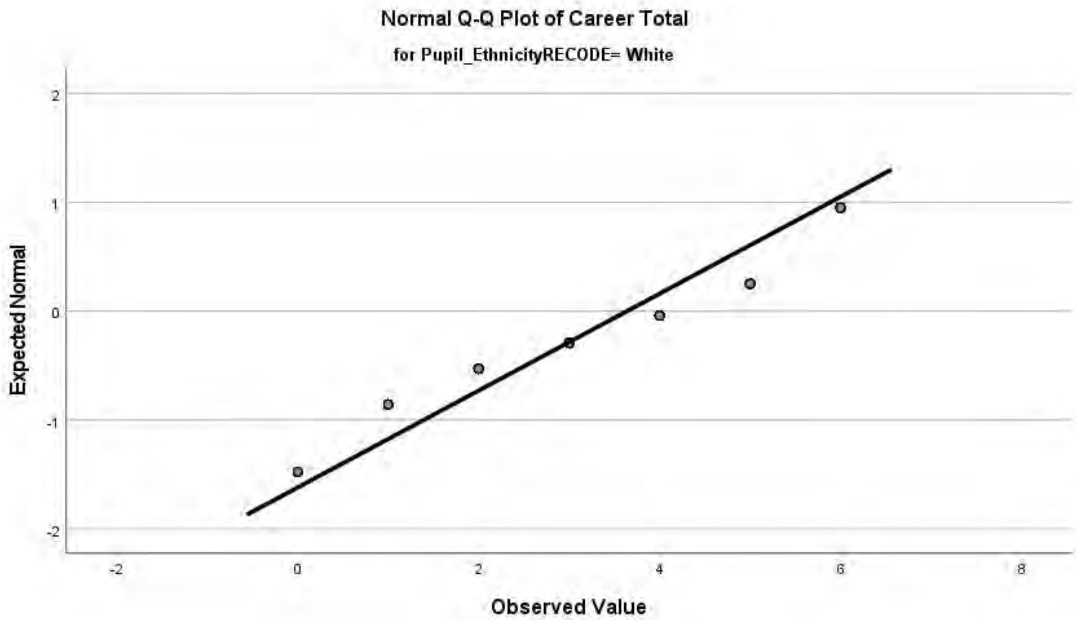
Ethnicity parametric assumptions

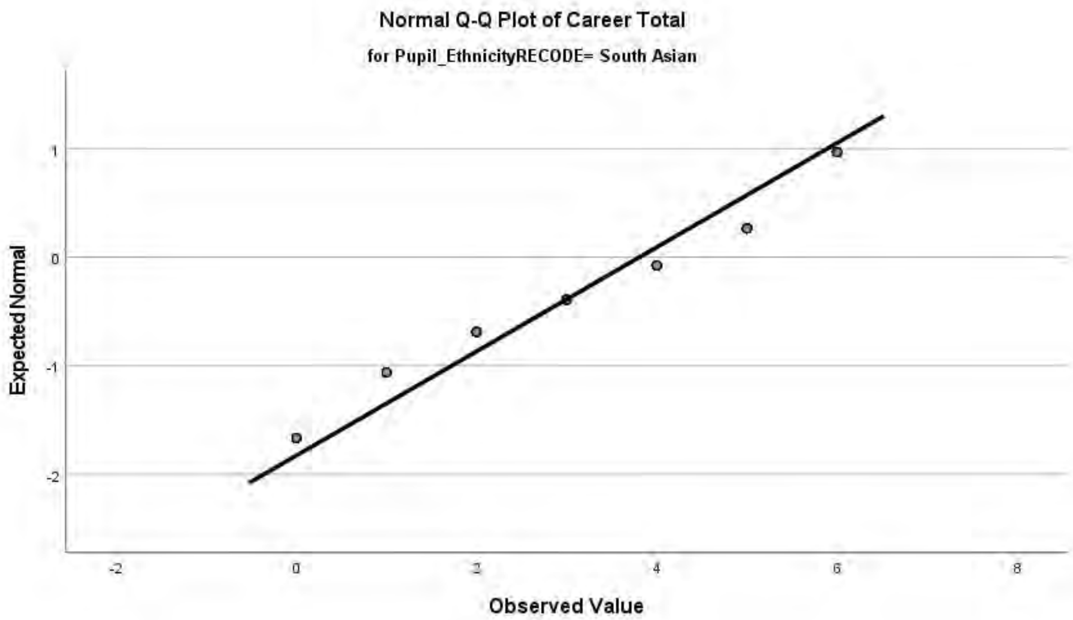
Descriptives

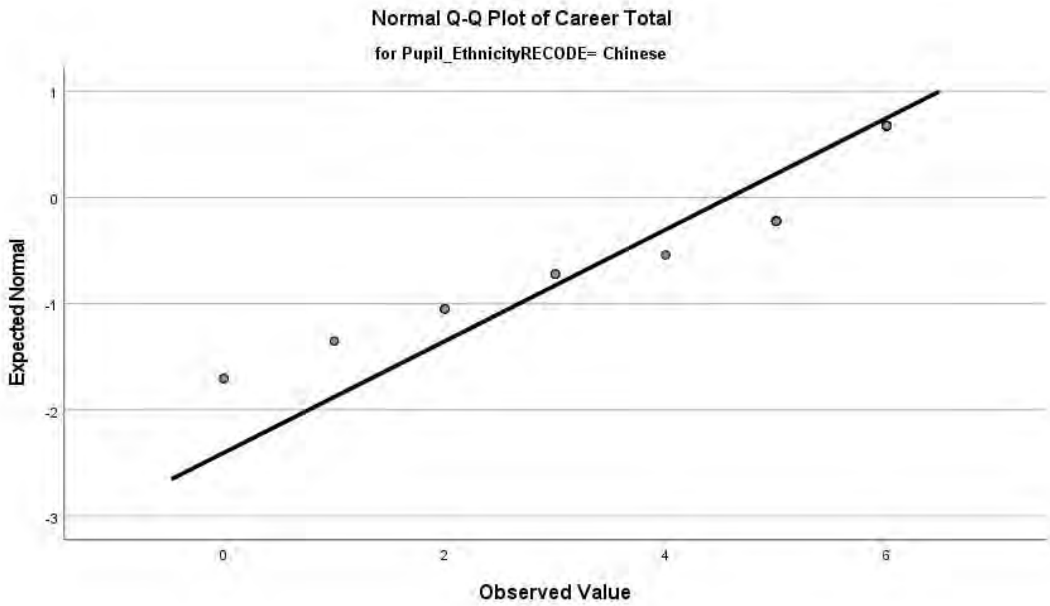
	What is your ethnicity?			Statistic	Std. Error
Career Total	White	Mean		3.6392	.07888
		95% Confidence Interval for Mean	Lower Bound	3.4843	
			Upper Bound	3.7940	
		5% Trimmed Mean		3.7102	
		Median		4.0000	
		Variance		5.052	
		Std. Deviation		2.24769	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		5.00	
		Skewness		-.391	.086
		Kurtosis		-1.368	.171
	South Asian	Mean		3.8085	.09830
		95% Confidence Interval for Mean	Lower Bound	3.6153	
			Upper Bound	4.0016	
		5% Trimmed Mean		3.8983	
		Median		4.0000	
		Variance		4.338	
		Std. Deviation		2.08284	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.483	.115
		Kurtosis		-1.133	.230
	Chinese	Mean		4.5758	.33152
		95% Confidence Interval for Mean	Lower Bound	3.9005	
			Upper Bound	5.2510	
		5% Trimmed Mean		4.7508	
		Median		5.0000	
		Variance		3.627	
		Std. Deviation		1.90444	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		-1.222	.409
		Kurtosis		.299	.798
	Black	Mean		4.0298	.16272
		95% Confidence Interval for Mean	Lower Bound	3.7085	
			Upper Bound	4.3510	
		5% Trimmed Mean		4.1442	
		Median		5.0000	
		Variance		4.448	
		Std. Deviation		2.10908	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.629	.187
		Kurtosis		-1.040	.373
	Mixed	Mean		3.5422	.24918
		95% Confidence Interval for Mean	Lower Bound	3.0465	
			Upper Bound	4.0379	
		5% Trimmed Mean		3.6024	
		Median		4.0000	
		Variance		5.154	
		Std. Deviation		2.27017	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		5.00	
		Skewness		-.373	.264
		Kurtosis		-1.342	.523

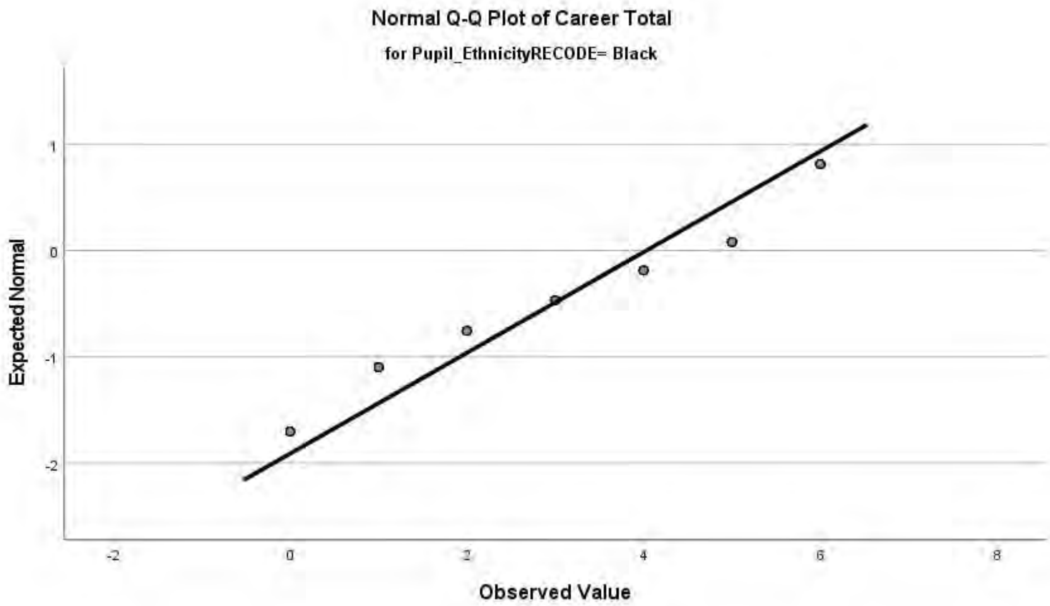
Test of Homogeneity of Variance

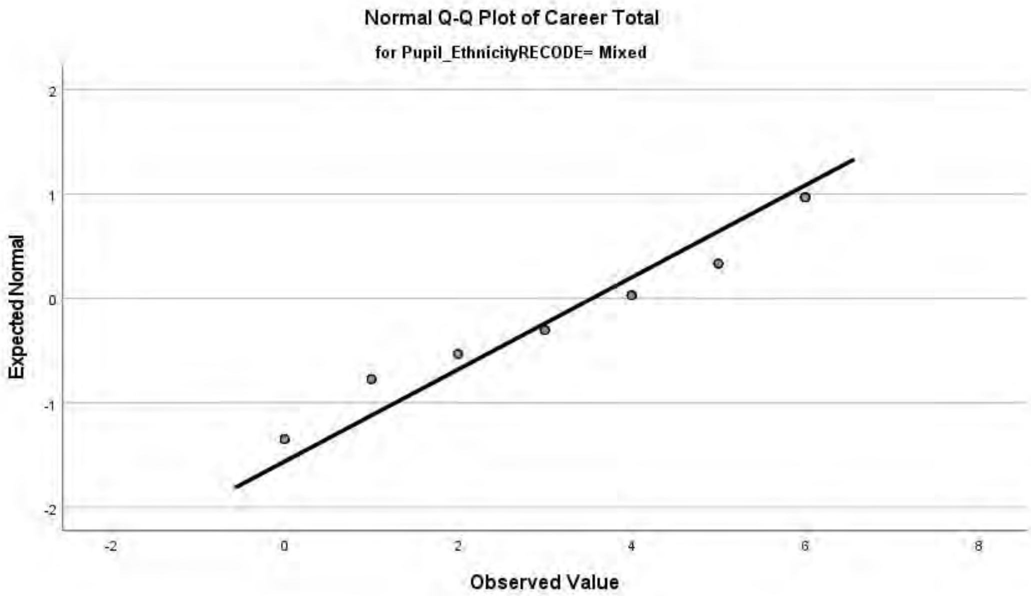
		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	4.484	4	1540	.001
	Based on Median	3.508	4	1540	.007
	Based on Median and with adjusted df	3.508	4	1480.288	.007
	Based on trimmed mean	4.758	4	1540	<.001






Normal Q-Q Plot of Career Total
for Pupil_EthnicityRECODE= Chinese
Expected Normal
1
0
-1
-2
-3
0
2
4
6
Observed Value


Normal Q-Q Plot of Career Total
for Pupil_EthnicityRECODE= Black
Expected Normal
1
0
-1
-2
-2
0
2
4
6
8
Observed Value



Ethnicity output

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Career Total is the same across categories of What is your ethnicity?.	Independent-Samples Kruskal-Wallis Test	.039	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Independent-Samples Kruskal-Wallis Test Summary

Total N	1545
Test Statistic	10.056[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	.039

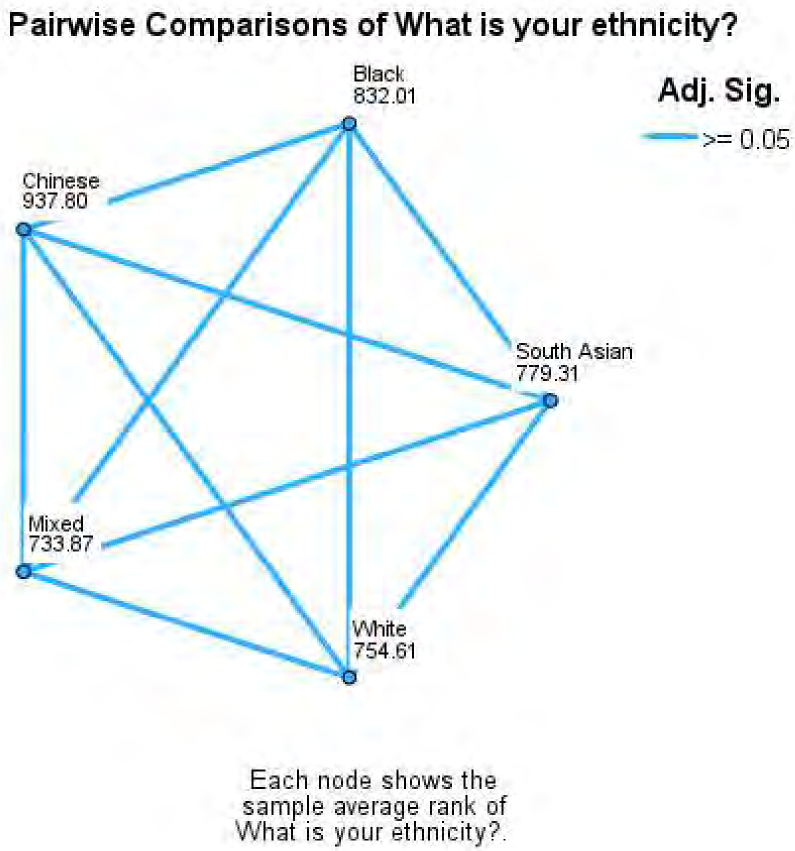
a. The test statistic is adjusted for ties.

Pairwise Comparisons of What is your ethnicity?

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Mixed-White	20.738	50.105	.414	.679	1.000
Mixed-South Asian	45.440	51.949	.875	.382	1.000
Mixed-Black	98.144	58.335	1.682	.092	.925
Mixed-Chinese	203.936	89.479	2.279	.023	.227
White-South Asian	-24.702	25.571	-.966	.334	1.000
White-Black	-77.407	36.853	-2.100	.036	.357
White-Chinese	-183.198	77.211	-2.373	.018	.177
South Asian-Black	-52.705	39.323	-1.340	.180	1.000
South Asian-Chinese	-158.496	78.421	-2.021	.043	.433
Black-Chinese	105.791	82.789	1.278	.201	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.



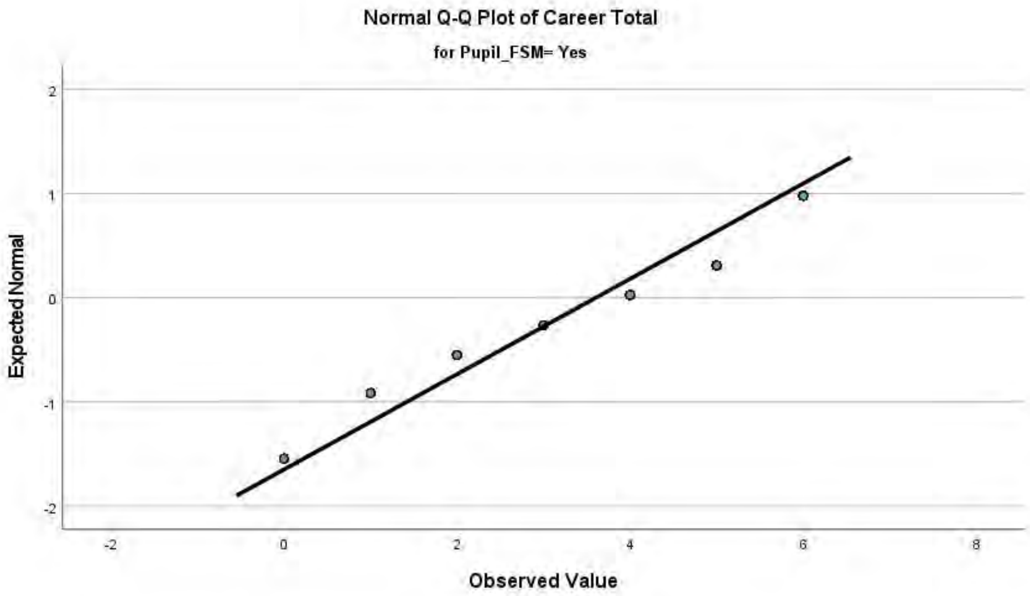
Free school meals parametric assumptions

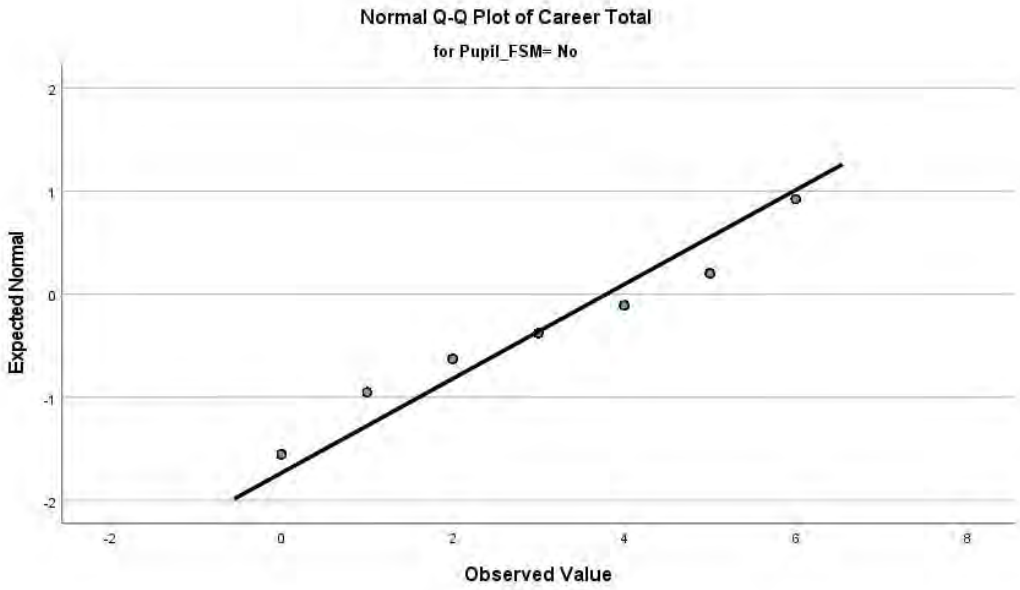
Descriptives

	Do you have free school meals?			Statistic	Std. Error
Career Total	Yes	Mean		3.6038	.09587
		95% Confidence Interval for Mean	Lower Bound	3.4155	
			Upper Bound	3.7922	
		5% Trimmed Mean		3.6709	
		Median		4.0000	
		Variance		4.779	
		Std. Deviation		2.18613	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.328	.107
		Kurtosis		-1.345	.214
	No	Mean		3.7911	.06467
		95% Confidence Interval for Mean	Lower Bound	3.6642	
			Upper Bound	3.9180	
		5% Trimmed Mean		3.8790	
		Median		4.0000	
		Variance		4.785	
		Std. Deviation		2.18743	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.500	.072
		Kurtosis		-1.222	.145

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	.104	1	1662	.747
	Based on Median	.118	1	1662	.732
	Based on Median and with adjusted df	.118	1	1661.847	.732
	Based on trimmed mean	.267	1	1662	.605





Free school meals output

Group Statistics

	Do you have free school meals?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Yes	520	3.6038	2.18613	.09587
	No	1144	3.7911	2.18743	.06467

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Career Total	Equal variances assumed	.104	.747	-1.619	1662	.053	.106	-.18724	.11567	-.41411	.03963
	Equal variances not assumed			-1.619	1004.410	.053	.106	-.18724	.11564	-.41417	.03969

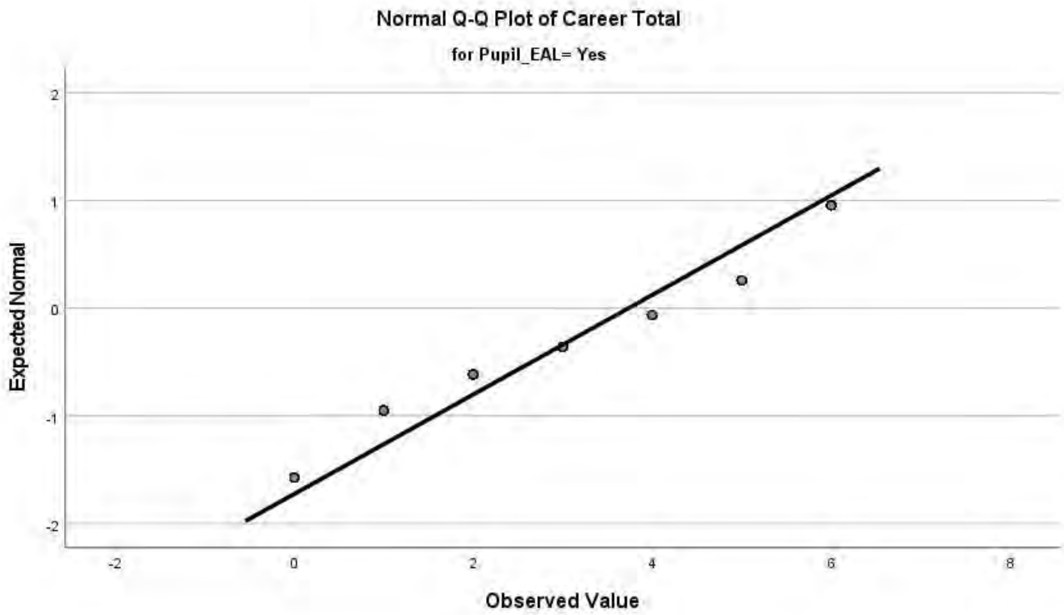
English as an additional language parametric assumption

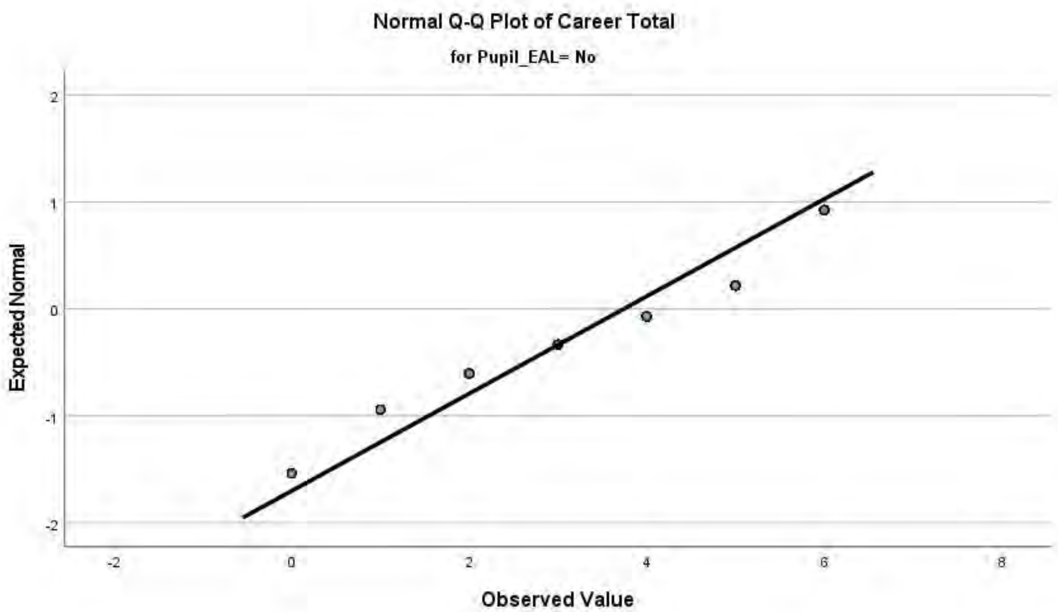
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
Career Total	Yes	Mean		3.7350	.08087
		95% Confidence Interval for Mean	Lower Bound	3.5762	
			Upper Bound	3.8938	
		5% Trimmed Mean		3.8167	
		Median		4.0000	
		Variance		4.689	
		Std. Deviation		2.16552	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.451	.091
		Kurtosis		-1.241	.182
	No	Mean		3.7408	.07140
		95% Confidence Interval for Mean	Lower Bound	3.6007	
			Upper Bound	3.8809	
		5% Trimmed Mean		3.8231	
		Median		4.0000	
		Variance		4.838	
		Std. Deviation		2.19950	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.448	.079
		Kurtosis		-1.277	.159

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	1.009	1	1664	.315
	Based on Median	1.006	1	1664	.316
	Based on Median and with adjusted df	1.006	1	1662.947	.316
	Based on trimmed mean	1.002	1	1664	.317





English as an additional language output

Group Statistics

	Do you speak English as an additional language?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Yes	717	3.7350	2.16552	.08087
	No	949	3.7408	2.19950	.07140

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Career Total	Equal variances assumed	1.009	.315	-.053	1664	.479	.957	-.00577	.10811	-.21783	.20628
	Equal variances not assumed			-.054	1554.061	.479	.957	-.00577	.10788	-.21738	.20583

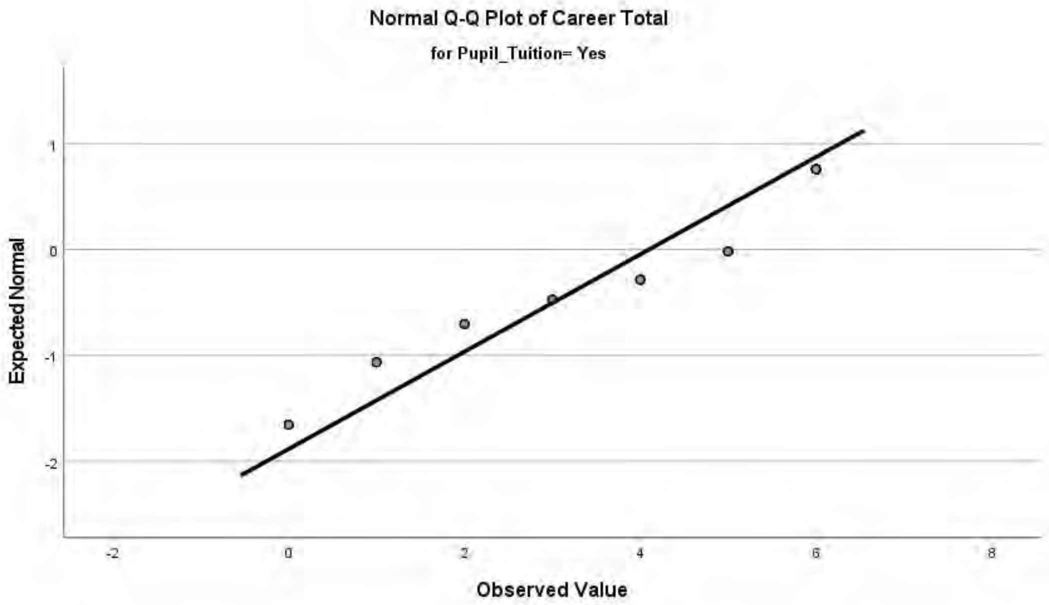
Extra maths tuition parametric assumptions

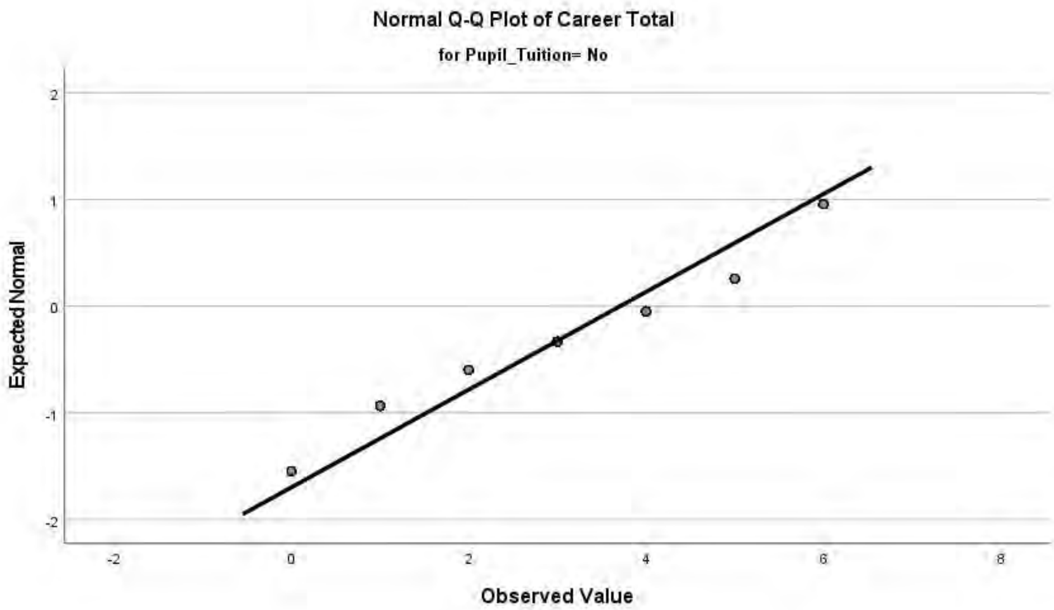
Descriptives

	Do you have extra maths tuition outside of school?			Statistic	Std. Error
Career Total	Yes	Mean		4.0986	.18247
		95% Confidence Interval for Mean	Lower Bound	3.7379	
			Upper Bound	4.4593	
		5% Trimmed Mean		4.2207	
		Median		5.0000	
		Variance		4.728	
		Std. Deviation		2.17435	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.703	.203
		Kurtosis		-1.053	.404
	No	Mean		3.7060	.05574
		95% Confidence Interval for Mean	Lower Bound	3.5967	
			Upper Bound	3.8153	
		5% Trimmed Mean		3.7844	
		Median		4.0000	
		Variance		4.766	
		Std. Deviation		2.18314	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.429	.062
		Kurtosis		-1.271	.125

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	.040	1	1674	.842
	Based on Median	.889	1	1674	.346
	Based on Median and with adjusted df	.889	1	1605.029	.346
	Based on trimmed mean	.060	1	1674	.807





Extra maths tuition output

Group Statistics

	Do you have extra maths tuition outside of school?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Yes	142	4.0986	2.17435	.18247
	No	1534	3.7060	2.18314	.05574

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Career Total	Equal variances assumed	.040	.842	2.051	1674	.020	.040	.39259	.19143	.01712	.76806
	Equal variances not assumed			2.058	168.409	.021	.041	.39259	.19079	.01594	.76924

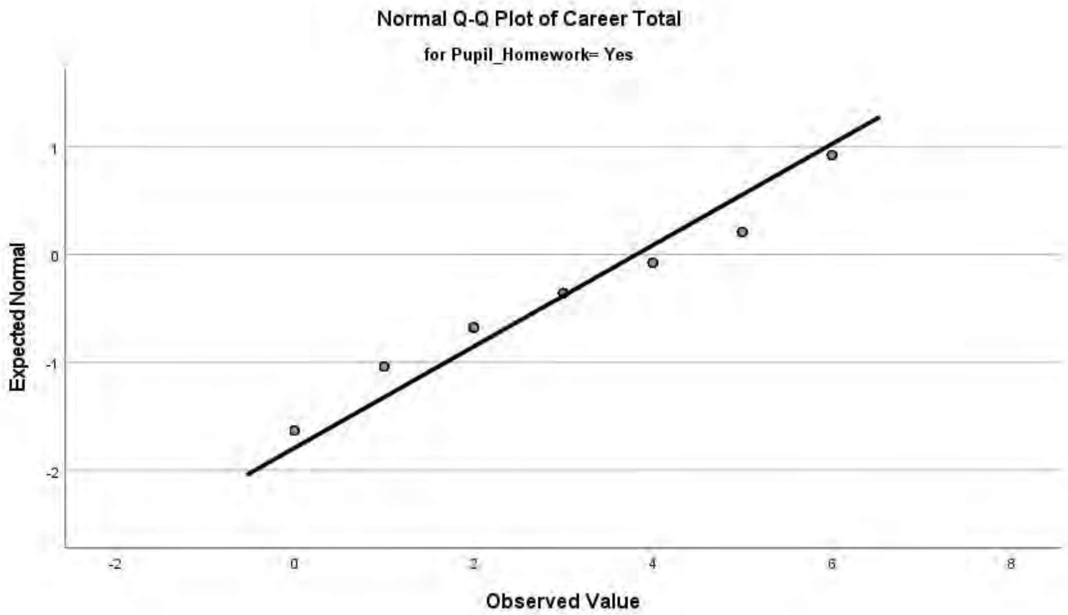
Parents help with homework parametric assumptions

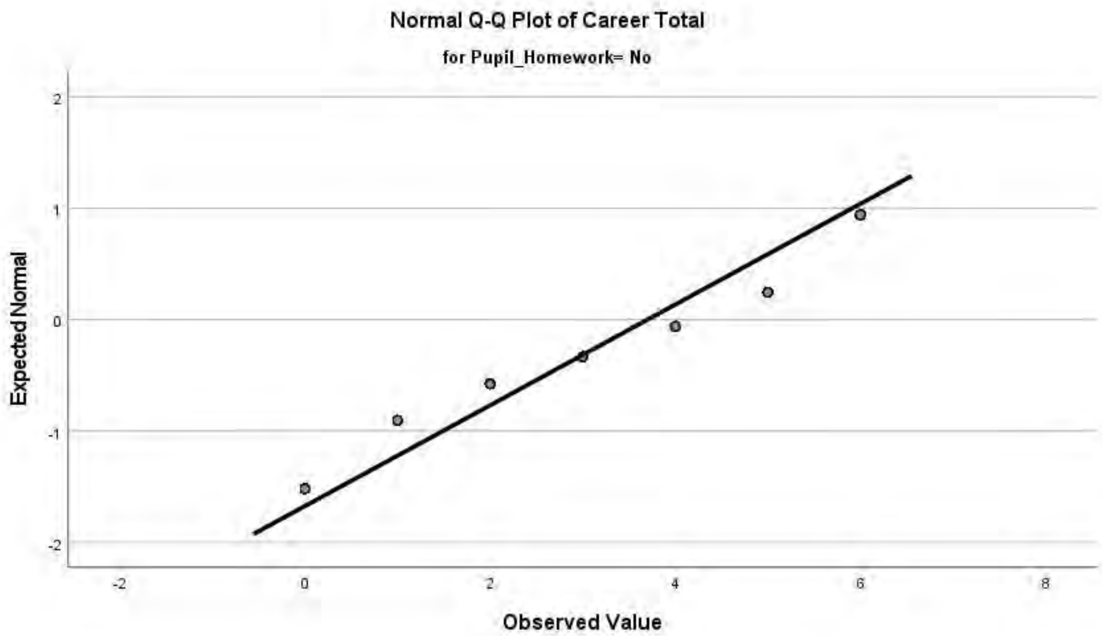
Descriptives

	Do your parents help you with your maths homework?			Statistic	Std. Error
Career Total	Yes	Mean		3.8178	.10287
		95% Confidence Interval for Mean	Lower Bound	3.6156	
			Upper Bound	4.0199	
		5% Trimmed Mean		3.9086	
		Median		4.0000	
		Variance		4.529	
		Std. Deviation		2.12809	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.474	.118
		Kurtosis		-1.193	.235
	No	Mean		3.7006	.06309
		95% Confidence Interval for Mean	Lower Bound	3.5768	
			Upper Bound	3.8244	
		5% Trimmed Mean		3.7784	
		Median		4.0000	
		Variance		4.892	
		Std. Deviation		2.21187	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.433	.070
		Kurtosis		-1.299	.139

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	2.183	1	1655	.140
	Based on Median	.948	1	1655	.330
	Based on Median and with adjusted df	.948	1	1647.744	.330
	Based on trimmed mean	2.129	1	1655	.145





Parents help with homework output

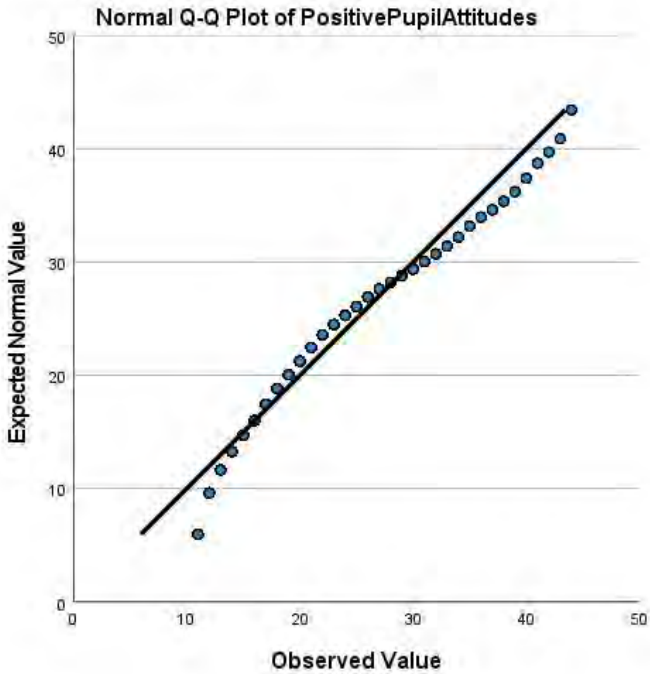
Group Statistics

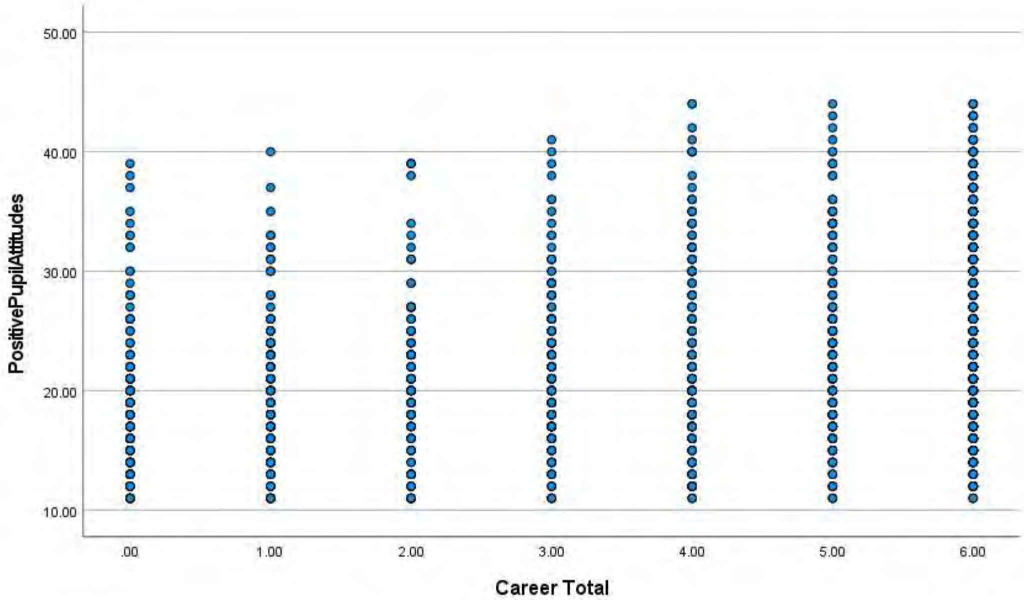
	Do your parents help you with your maths homework?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Yes	428	3.8178	2.12809	.10287
	No	1229	3.7006	2.21187	.06309

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Career Total	Equal variances assumed	2.183	.140	.953	1655	.170	.341	.11719	.12295	-.12396	.35834
	Equal variances not assumed			.971	770.784	.166	.332	.11719	.12067	-.11970	.35407

Pupils' attitudes parametric assumptions





Pupils attitudes output

Correlations

			PositivePupilAttitudes	Career Total
Spearman's rho	PositivePupilAttitudes	Correlation Coefficient	1.000	.294**
		Sig. (2-tailed)	.	<.001
		N	1605	1600
	Career Total	Correlation Coefficient	.294**	1.000
		Sig. (2-tailed)	<.001	.
		N	1600	1692

**. Correlation is significant at the 0.01 level (2-tailed).

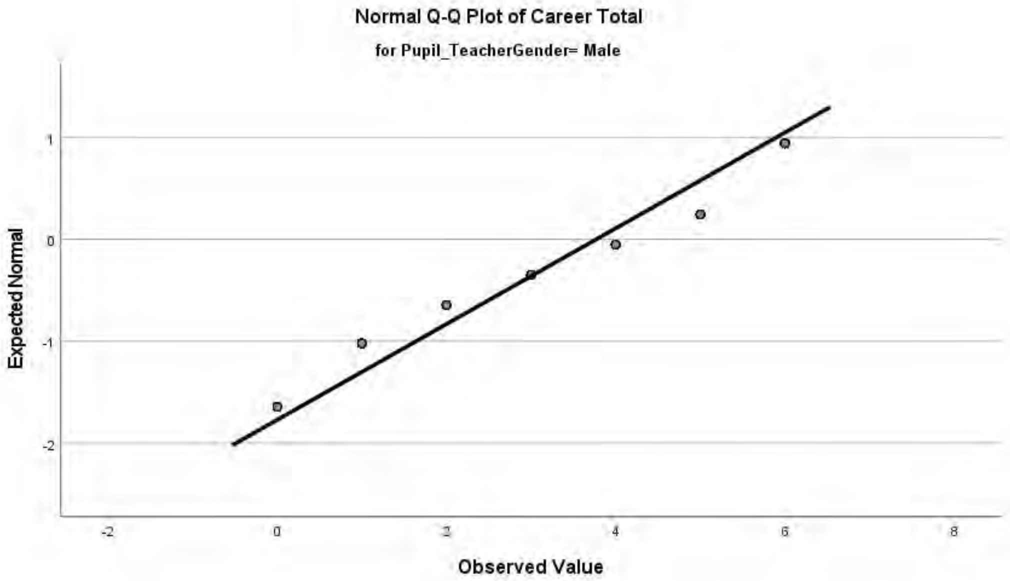
Teacher gender parametric assumptions

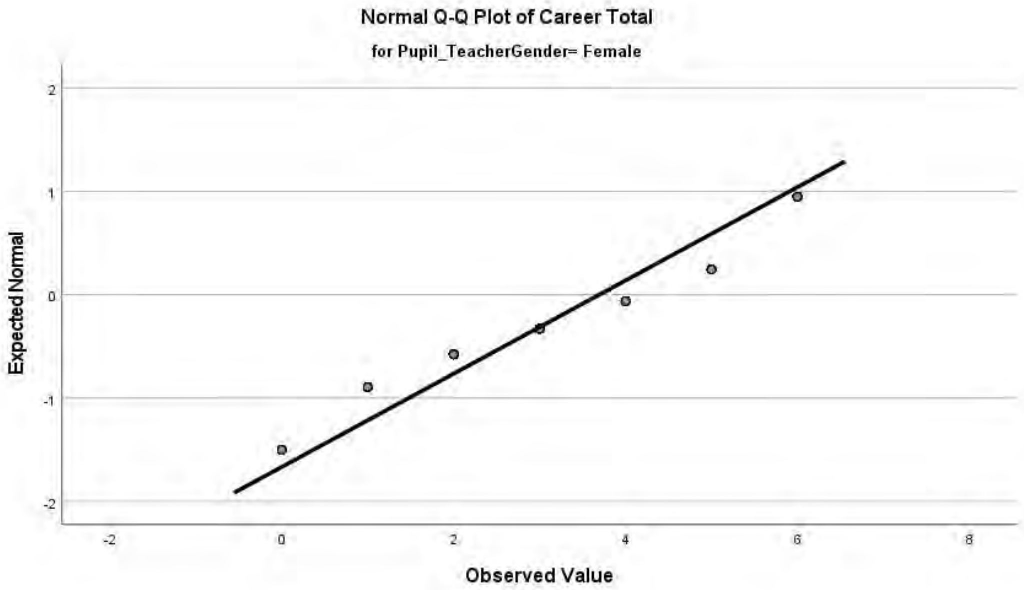
Descriptives

	Is your maths teacher male or female?			Statistic	Std. Error
Career Total	Male	Mean		3.7703	.08411
		95% Confidence Interval for Mean	Lower Bound	3.6051	
			Upper Bound	3.9355	
		5% Trimmed Mean		3.8559	
		Median		4.0000	
		Variance		4.528	
		Std. Deviation		2.12785	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.436	.097
		Kurtosis		-1.230	.193
	Female	Mean		3.6936	.07088
		95% Confidence Interval for Mean	Lower Bound	3.5545	
			Upper Bound	3.8327	
		5% Trimmed Mean		3.7706	
		Median		4.0000	
		Variance		4.918	
		Std. Deviation		2.21772	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.436	.078
		Kurtosis		-1.299	.156

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	3.382	1	1617	.066
	Based on Median	2.012	1	1617	.156
	Based on Median and with adjusted df	2.012	1	1613.105	.156
	Based on trimmed mean	3.291	1	1617	.070





Teacher gender output

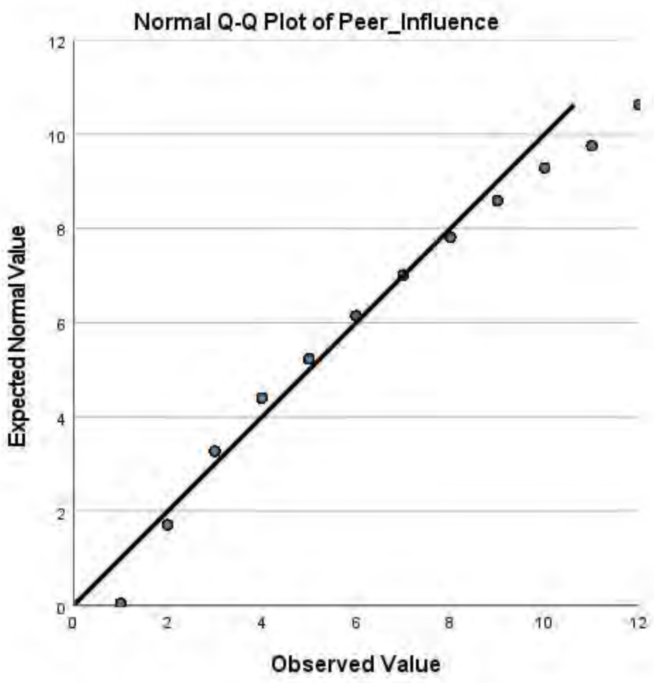
Group Statistics

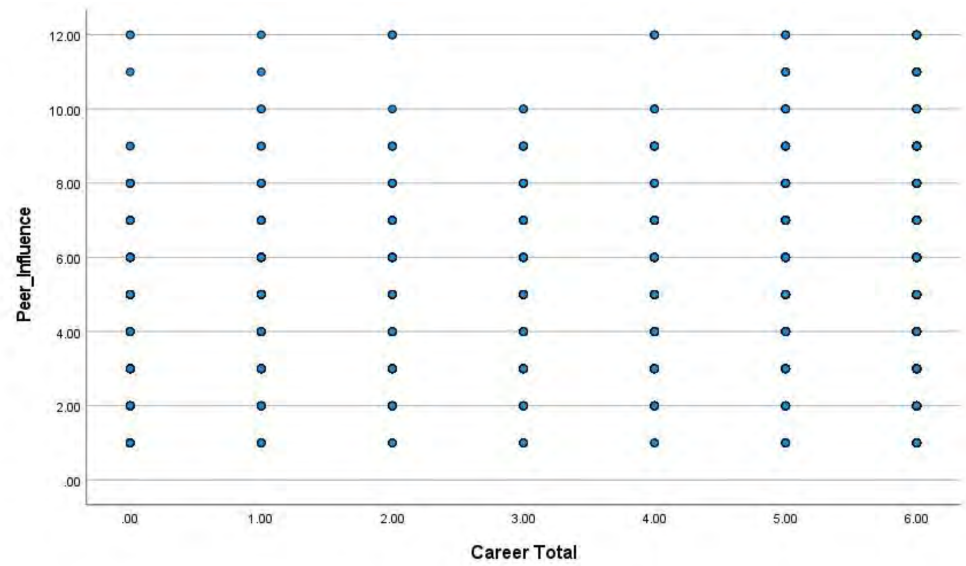
	Is your maths teacher male or female?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Male	640	3.7703	2.12785	.08411
	Female	979	3.6936	2.21772	.07088

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Career Total	Equal variances assumed	3.382	.066	.692	1617	.245	.489	.07675	.11095	-.14087	.29437
	Equal variances not assumed			.698	1405.631	.243	.485	.07675	.10999	-.13902	.29252

Peer attitudes parametric assumption





Peer attitudes output

Correlations

			Career Total	Peer_Influence
Spearman's rho	Career Total	Correlation Coefficient	1.000	.166**
		Sig. (2-tailed)	.	<.001
		N	1692	1542
	Peer_Influence	Correlation Coefficient	.166**	1.000
		Sig. (2-tailed)	<.001	.
		N	1542	1545

**. Correlation is significant at the 0.01 level (2-tailed).

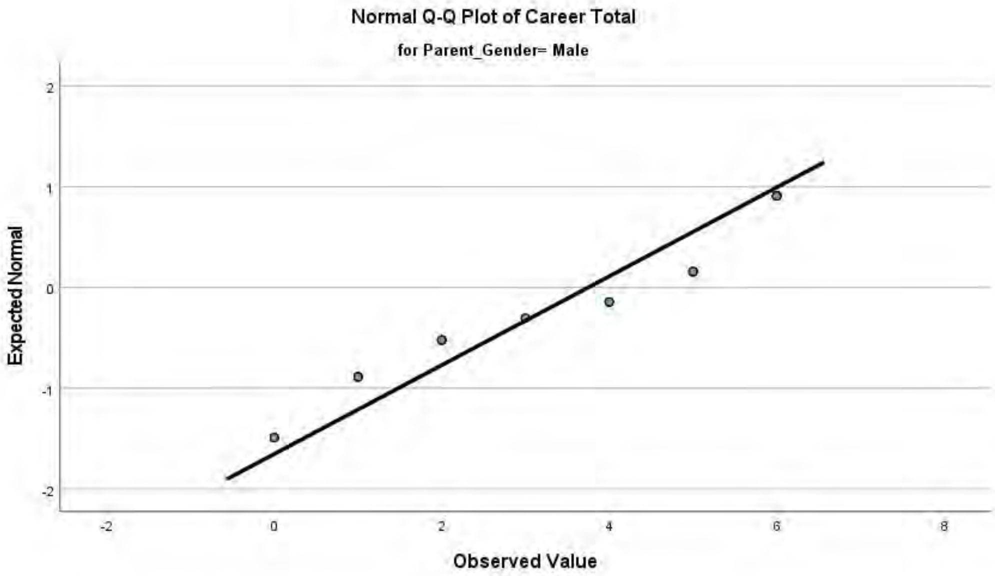
Parent gender parametric assumptions

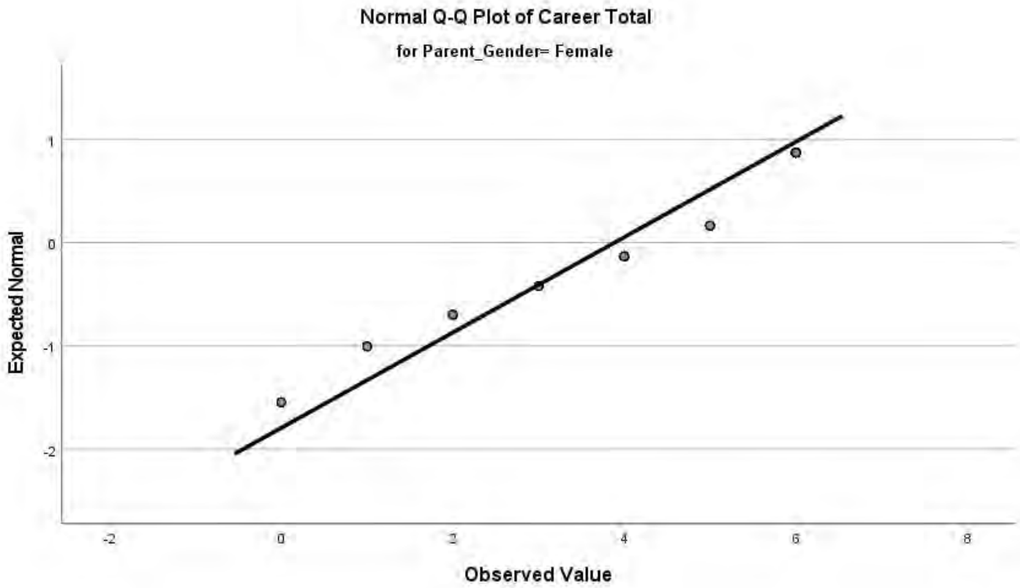
Descriptives

	What is your gender?			Statistic	Std. Error
Career Total	Male	Mean		3.7471	.24317
		95% Confidence Interval for Mean	Lower Bound	3.2637	
			Upper Bound	4.2305	
		5% Trimmed Mean		3.8301	
		Median		5.0000	
		Variance		5.145	
		Std. Deviation		2.26817	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.468	.258
		Kurtosis		-1.381	.511
	Female	Mean		3.8860	.14332
		95% Confidence Interval for Mean	Lower Bound	3.6036	
			Upper Bound	4.1684	
		5% Trimmed Mean		3.9844	
		Median		4.0000	
		Variance		4.683	
		Std. Deviation		2.16402	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.570	.161
		Kurtosis		-1.101	.321

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	1.726	1	313	.190
	Based on Median	.491	1	313	.484
	Based on Median and with adjusted df	.491	1	266.942	.484
	Based on trimmed mean	1.726	1	313	.190





Parents gender output

Group Statistics

	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Male	87	3.7471	2.26817	.24317
	Female	228	3.8860	2.16402	.14332

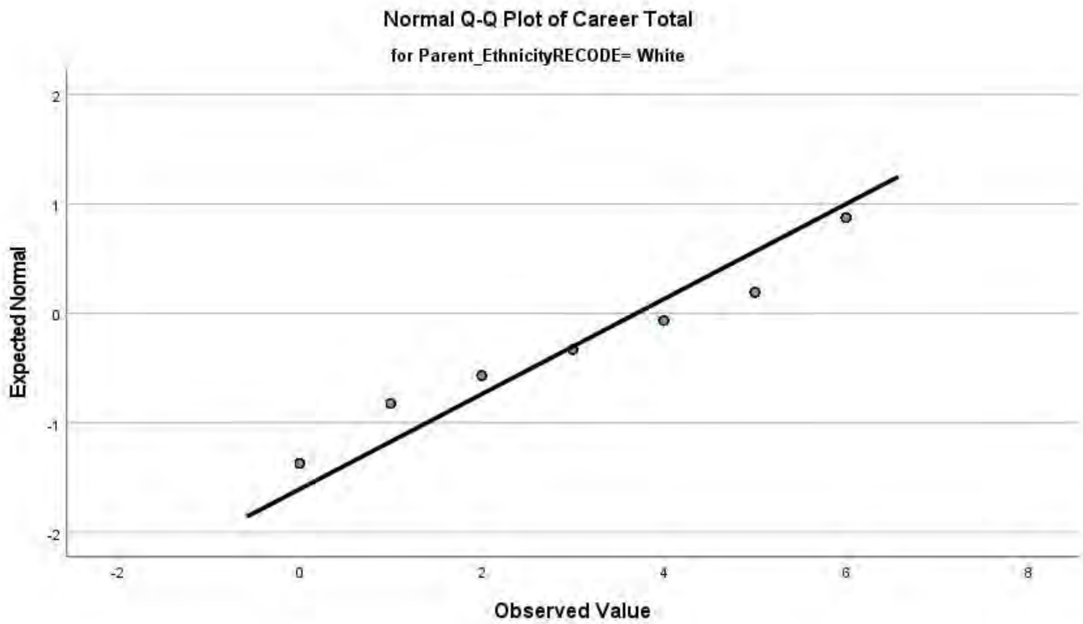
Independent Samples Test

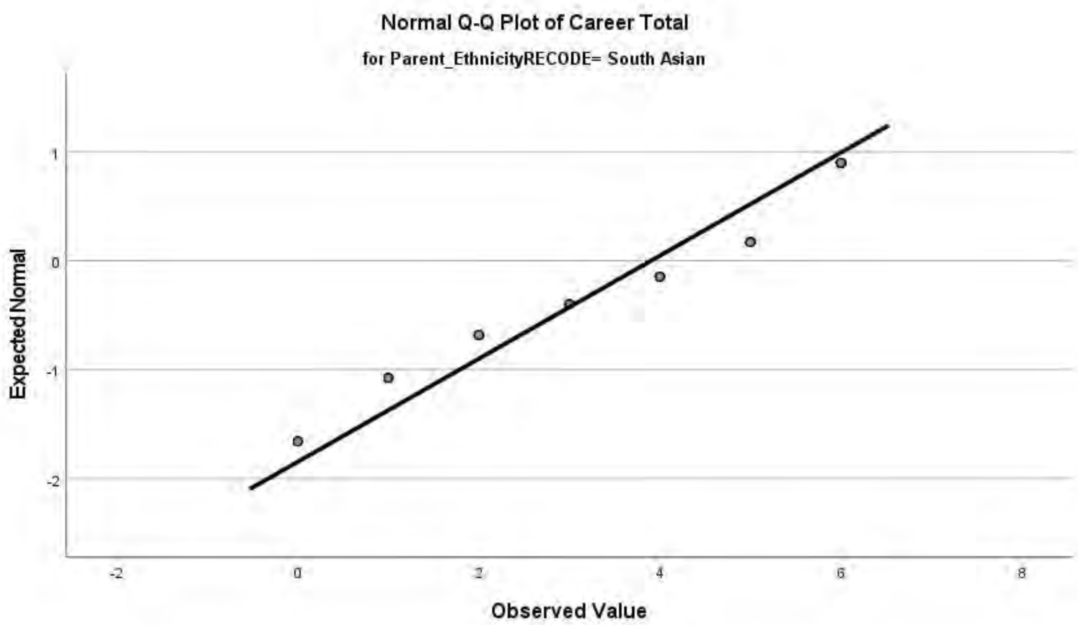
		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p			Lower	Upper
Career Total	Equal variances assumed	1.726	.190	-.502	313	.308	.616	-.13884	.27637	-.68262	.40494
	Equal variances not assumed			-.492	149.294	.312	.624	-.13884	.28226	-.69659	.41891

Parent ethnicity parametric assumptions

Descriptives

	What is your ethnicity?			Statistic	Std. Error
Career Total	White	Mean		3.6982	.17721
		95% Confidence Interval for Mean	Lower Bound	3.3484	
			Upper Bound	4.0481	
		5% Trimmed Mean		3.7758	
		Median		4.0000	
		Variance		5.307	
		Std. Deviation		2.30374	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.459	.187
		Kurtosis		-1.327	.371
	South Asian	Mean		3.9020	.20924
		95% Confidence Interval for Mean	Lower Bound	3.4869	
			Upper Bound	4.3170	
		5% Trimmed Mean		4.0022	
		Median		4.5000	
		Variance		4.466	
		Std. Deviation		2.11318	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.543	.239
		Kurtosis		-1.144	.474
	Chinese	Mean		5.3333	.33333
		95% Confidence Interval for Mean	Lower Bound	3.8991	
			Upper Bound	6.7676	
		5% Trimmed Mean		.	
		Median		5.0000	
		Variance		.333	
		Std. Deviation		.57735	
		Minimum		5.00	
		Maximum		6.00	
		Range		1.00	
		Interquartile Range		.	
		Skewness		1.732	1.225
		Kurtosis		.	.
	Black	Mean		4.5769	.33362
		95% Confidence Interval for Mean	Lower Bound	3.8898	
			Upper Bound	5.2640	
		5% Trimmed Mean		4.6966	
		Median		5.0000	
		Variance		2.894	
		Std. Deviation		1.70113	
		Minimum		1.00	
		Maximum		6.00	
		Range		5.00	
		Interquartile Range		2.25	
		Skewness		-1.014	.456
		Kurtosis		-.290	.887
	Mixed	Mean		3.3750	.80039
		95% Confidence Interval for Mean	Lower Bound	1.4824	
			Upper Bound	5.2676	
		5% Trimmed Mean		3.4167	
		Median		3.5000	
		Variance		5.125	
		Std. Deviation		2.26385	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.50	
		Skewness		-.226	.752
		Kurtosis		-1.412	1.481


Normal Q-Q Plot of Career Total
for Parent_EthnicityRECODE= White
Expected Normal
Observed Value
2
1
0
-1
-2
-2
0
2
4
6
8


Normal Q-Q Plot of Career Total
for Parent_EthnicityRECODE= South Asian
Expected Normal
Observed Value
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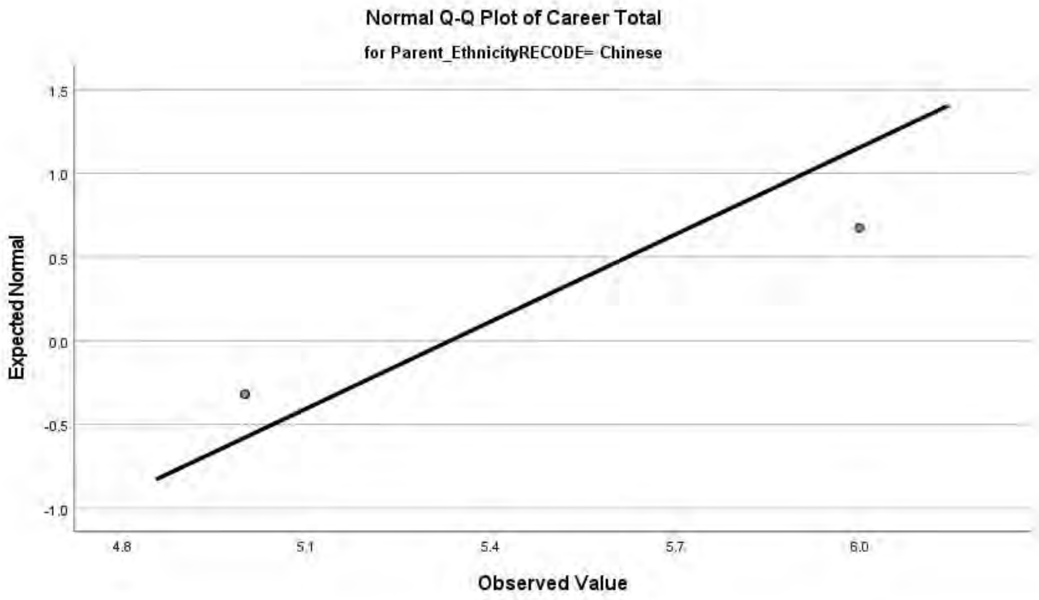
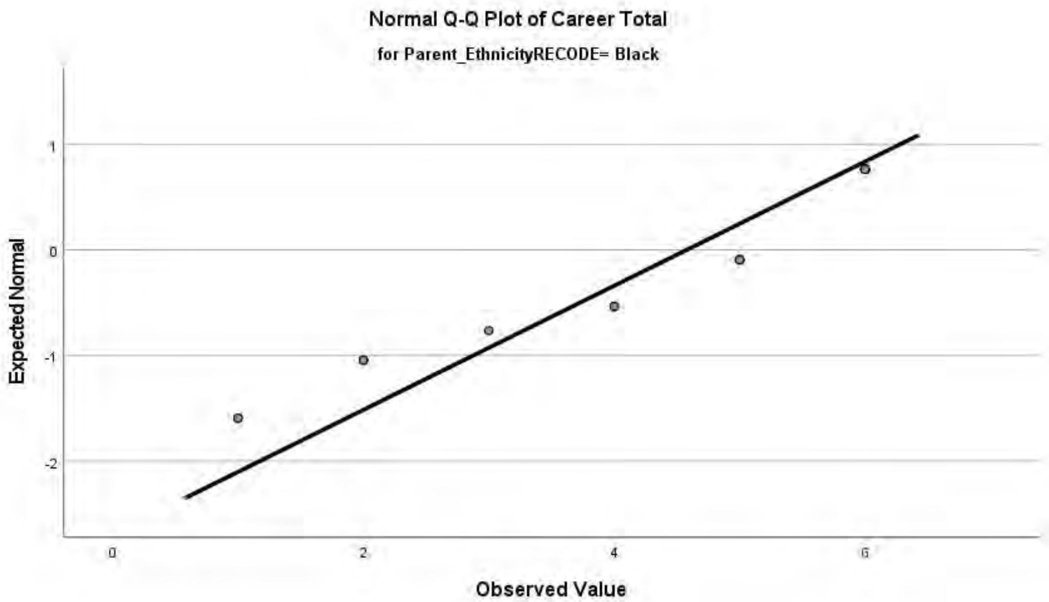
0
-1
-2
-2
0
2
4
6
8





Parent ethnicity output

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Career Total is the same across categories of What is your ethnicity?.	Independent-Samples Kruskal-Wallis Test	.268	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Independent-Samples Kruskal-Wallis Test Summary

Total N	297
Test Statistic	2.637[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	.268

a. The test statistic is adjusted for ties.

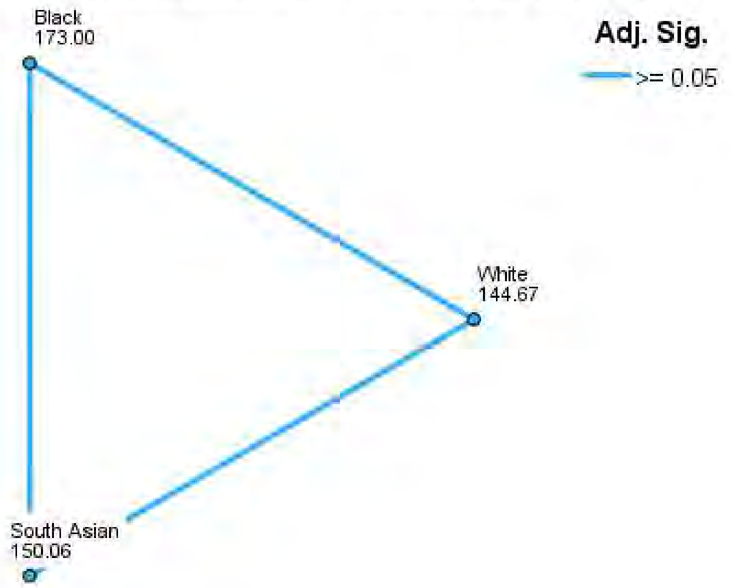
Pairwise Comparisons of What is your ethnicity?

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
White-South Asian	-5.398	10.435	-.517	.605	1.000
White-Black	-28.334	17.533	-1.616	.106	.318
South Asian-Black	-22.936	18.284	-1.254	.210	.629

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Pairwise Comparisons of What is your ethnicity?



Each node shows the sample average rank of What is your ethnicity?.

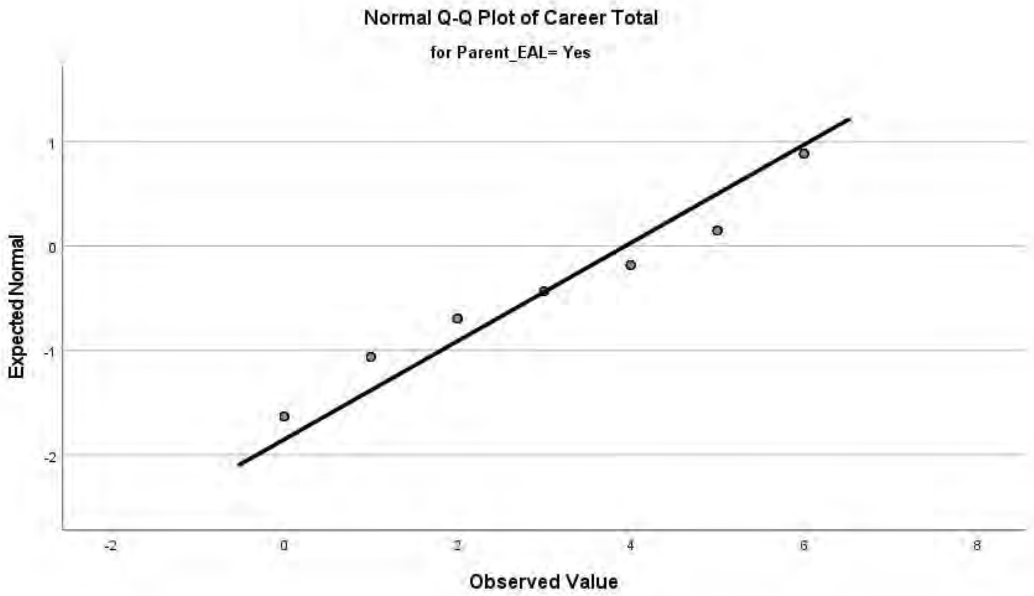
Parent English as an Additional Language parametric assumptions

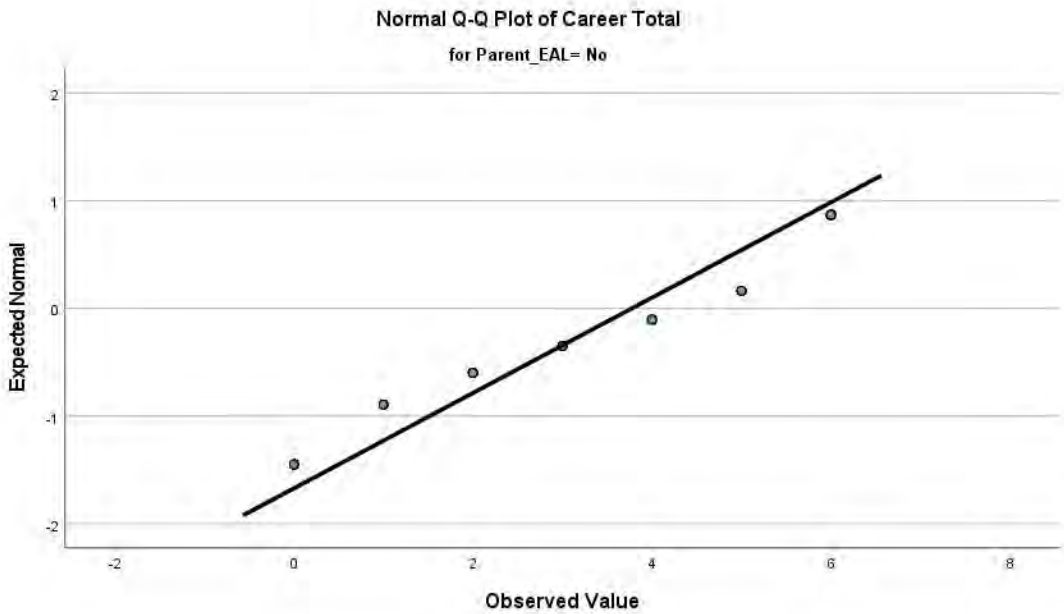
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
Career Total	Yes	Mean		3.9379	.17650
		95% Confidence Interval for Mean	Lower Bound	3.5891	
			Upper Bound	4.2868	
		5% Trimmed Mean		4.0421	
		Median		5.0000	
		Variance		4.517	
		Std. Deviation		2.12531	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.595	.201
		Kurtosis		-1.087	.400
	No	Mean		3.7738	.17441
		95% Confidence Interval for Mean	Lower Bound	3.4295	
			Upper Bound	4.1181	
		5% Trimmed Mean		3.8598	
		Median		4.0000	
		Variance		5.110	
		Std. Deviation		2.26058	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		-.496	.187
		Kurtosis		-1.278	.373

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Career Total	Based on Mean	1.929	1	311	.166
	Based on Median	1.082	1	311	.299
	Based on Median and with adjusted df	1.082	1	284.765	.299
	Based on trimmed mean	1.830	1	311	.177





Parent English as an Additional Language output

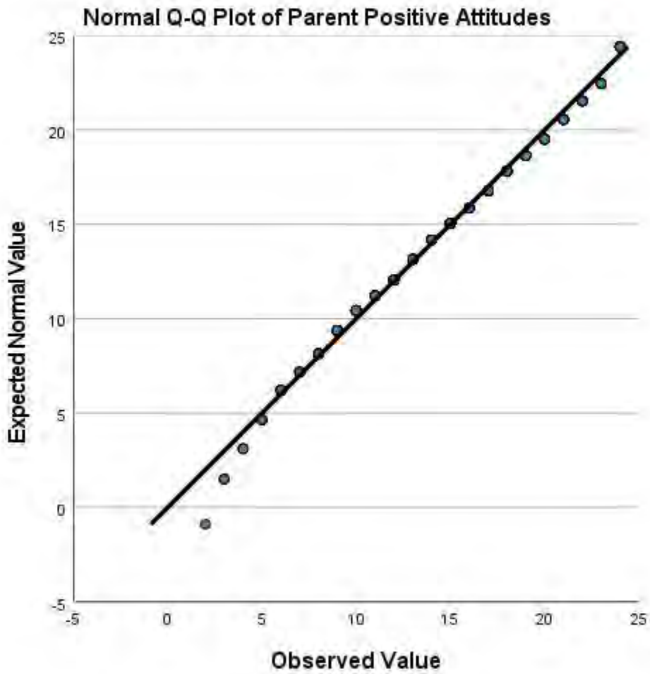
Group Statistics

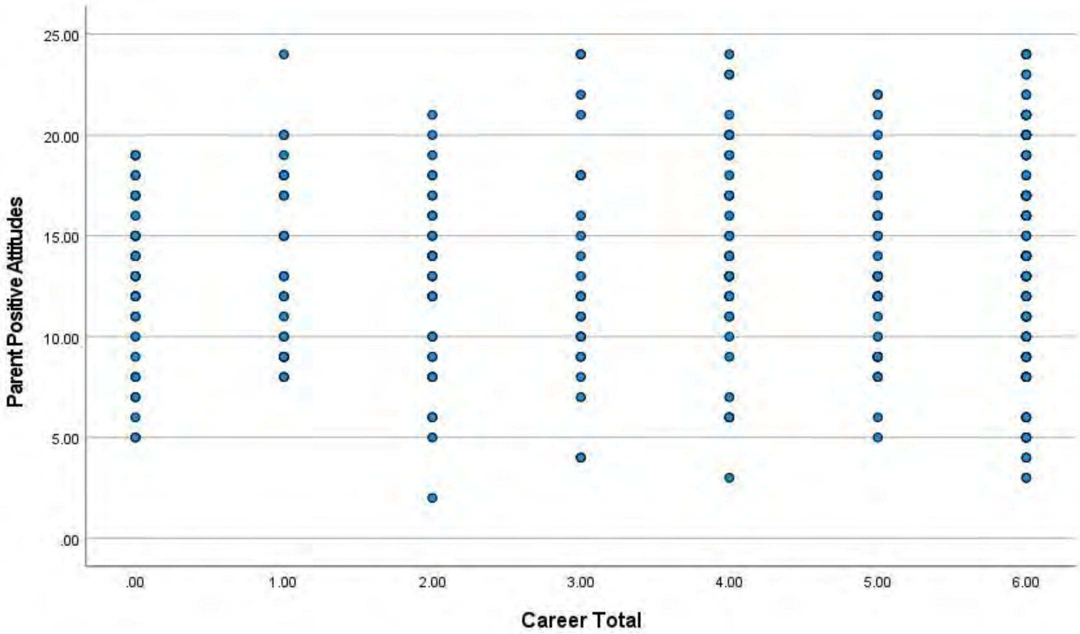
	Do you speak English as an additional language?	N	Mean	Std. Deviation	Std. Error Mean
Career Total	Yes	145	3.9379	2.12531	.17650
	No	168	3.7738	2.26058	.17441

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Career Total	Equal variances assumed	1.929	.166	.658	311	.255	.511	.16412	.24926	-.32633	.65457
	Equal variances not assumed			.661	308.711	.254	.509	.16412	.24813	-.32412	.65236

Parents attitudes parametric assumption





Parents attitudes output

Correlations

			Career Total	Parent Positive Attitudes
Spearman's rho	Career Total	Correlation Coefficient	1.000	.069
		Sig. (2-tailed)	.	.226
		N	1692	309
	Parent Positive Attitudes	Correlation Coefficient	.069	1.000
		Sig. (2-tailed)	.226	.
		N	309	368

Appendix E.3: Relevance

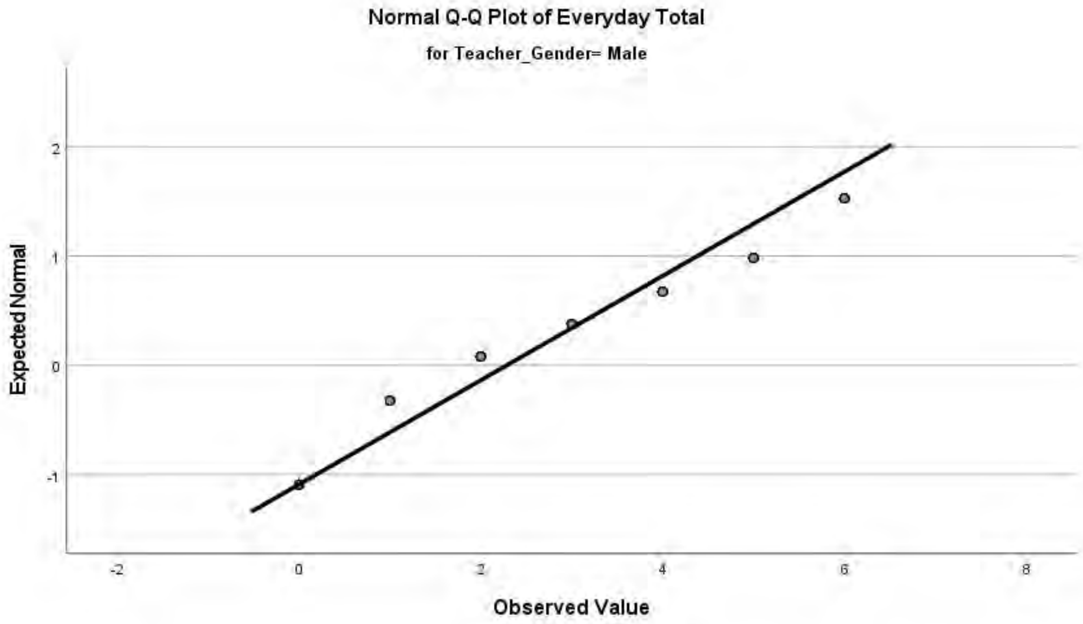
Gender parametric assumptions

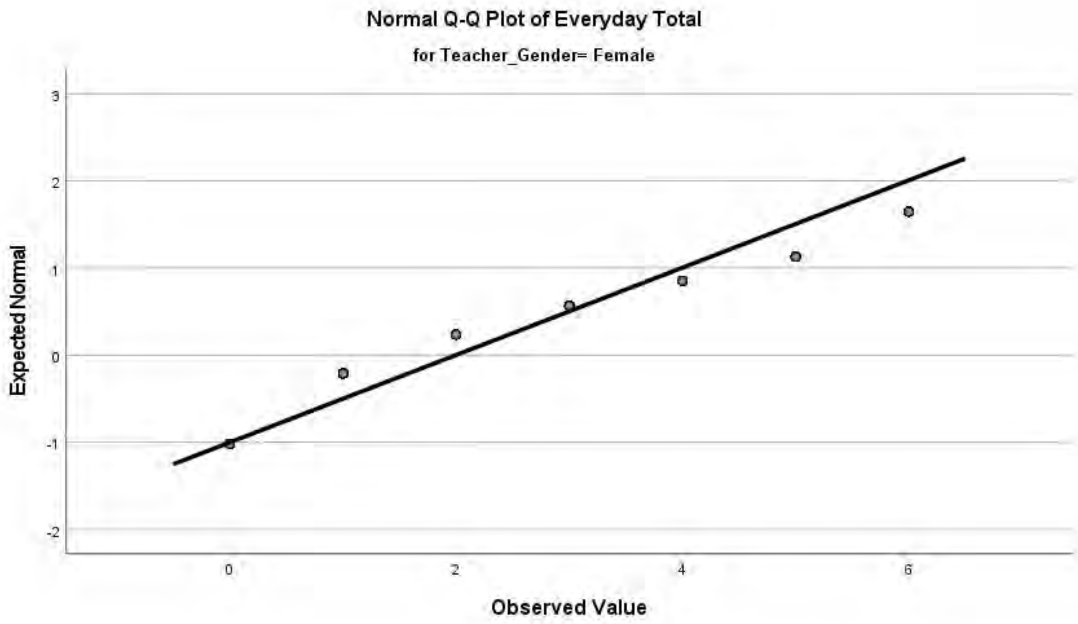
Descriptives

	What is your gender?			Statistic	Std. Error
Everyday Total	Male	Mean		2.2854	.09238
		95% Confidence Interval for Mean	Lower Bound	2.1039	
			Upper Bound	2.4669	
		5% Trimmed Mean		2.2060	
		Median		2.0000	
		Variance		4.395	
		Std. Deviation		2.09643	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.516	.108
		Kurtosis		-1.093	.215
	Female	Mean		1.9943	.06747
		95% Confidence Interval for Mean	Lower Bound	1.8619	
			Upper Bound	2.1267	
		5% Trimmed Mean		1.8825	
		Median		1.0000	
		Variance		3.978	
		Std. Deviation		1.99454	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.761	.083
		Kurtosis		-.673	.165

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	7.881	1	1387	.005
	Based on Median	4.441	1	1387	.035
	Based on Median and with adjusted df	4.441	1	1300.974	.035
	Based on trimmed mean	6.806	1	1387	.009





Gender output

Ranks

	What is your gender?	N	Mean Rank	Sum of Ranks
Total everyday score	Male	988	791.45	781956.50
	Female	637	846.42	539168.50
	Total	1625		

Test Statistics[a]

	Total everyday score
Mann-Whitney U	293390.500
Wilcoxon W	781956.500
Z	-2.341
Asymp. Sig. (2-tailed)	.019

a. Grouping Variable: What is your gender?

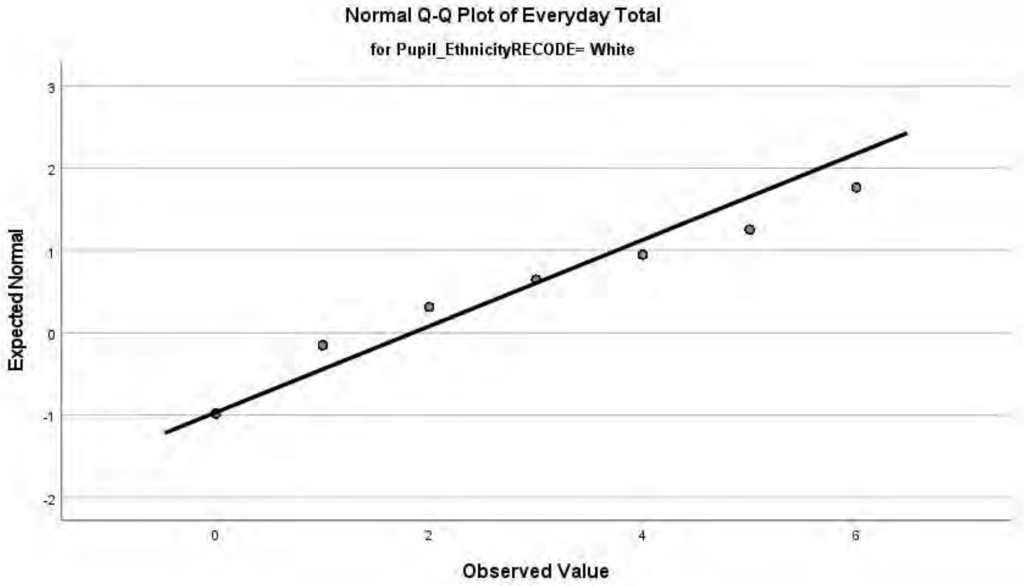
Ethnicity parametric assumptions

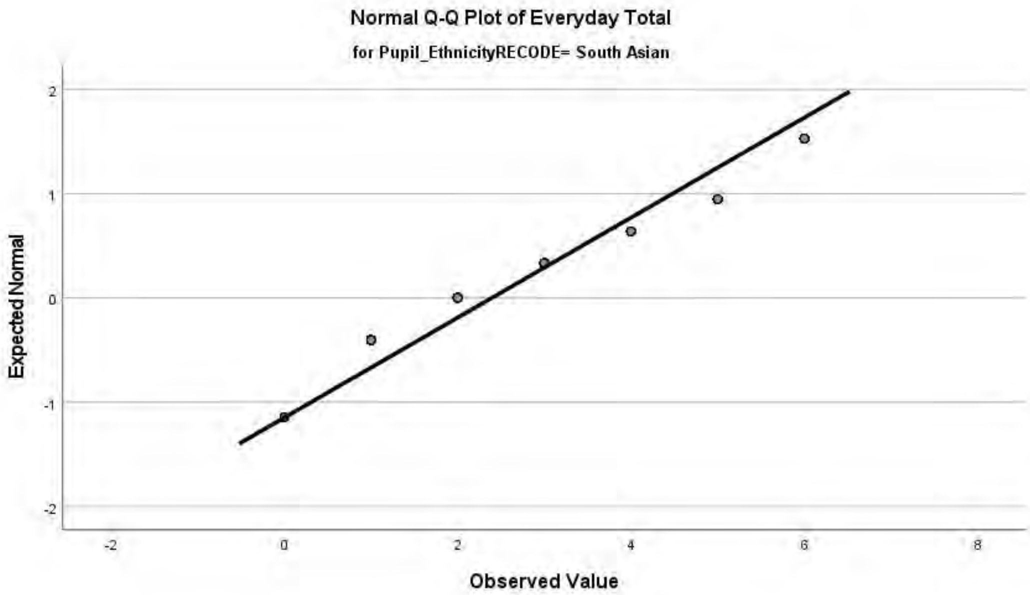
Descriptives

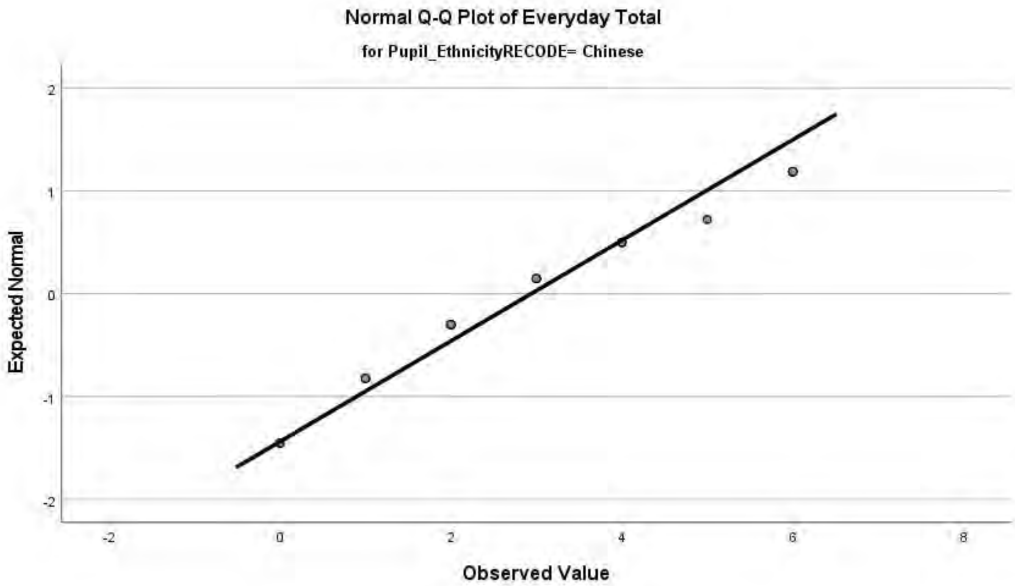
	What is your ethnicity?			Statistic	Std. Error
Everyday Total	White	Mean		1.8438	.06691
		95% Confidence Interval for Mean	Lower Bound	1.7125	
			Upper Bound	1.9751	
		5% Trimmed Mean		1.7153	
		Median		1.0000	
		Variance		3.639	
		Std. Deviation		1.90771	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.862	.086
		Kurtosis		-.423	.171
	South Asian	Mean		2.3933	.09832
		95% Confidence Interval for Mean	Lower Bound	2.2001	
			Upper Bound	2.5866	
		5% Trimmed Mean		2.3259	
		Median		2.0000	
		Variance		4.351	
		Std. Deviation		2.08579	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.436	.115
		Kurtosis		-1.147	.230
	Chinese	Mean		2.9394	.35606
		95% Confidence Interval for Mean	Lower Bound	2.2141	
			Upper Bound	3.6647	
		5% Trimmed Mean		2.9327	
		Median		3.0000	
		Variance		4.184	
		Std. Deviation		2.04541	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.50	
		Skewness		.273	.409
		Kurtosis		-1.123	.798
	Black	Mean		2.5868	.16211
		95% Confidence Interval for Mean	Lower Bound	2.2668	
			Upper Bound	2.9069	
		5% Trimmed Mean		2.5409	
		Median		2.0000	
		Variance		4.389	
		Std. Deviation		2.09487	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.286	.188
		Kurtosis		-1.207	.374
	Mixed	Mean		1.7439	.22546
		95% Confidence Interval for Mean	Lower Bound	1.2953	
			Upper Bound	2.1925	
		5% Trimmed Mean		1.6043	
		Median		1.0000	
		Variance		4.168	
		Std. Deviation		2.04161	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		1.079	.266
		Kurtosis		-.117	.526

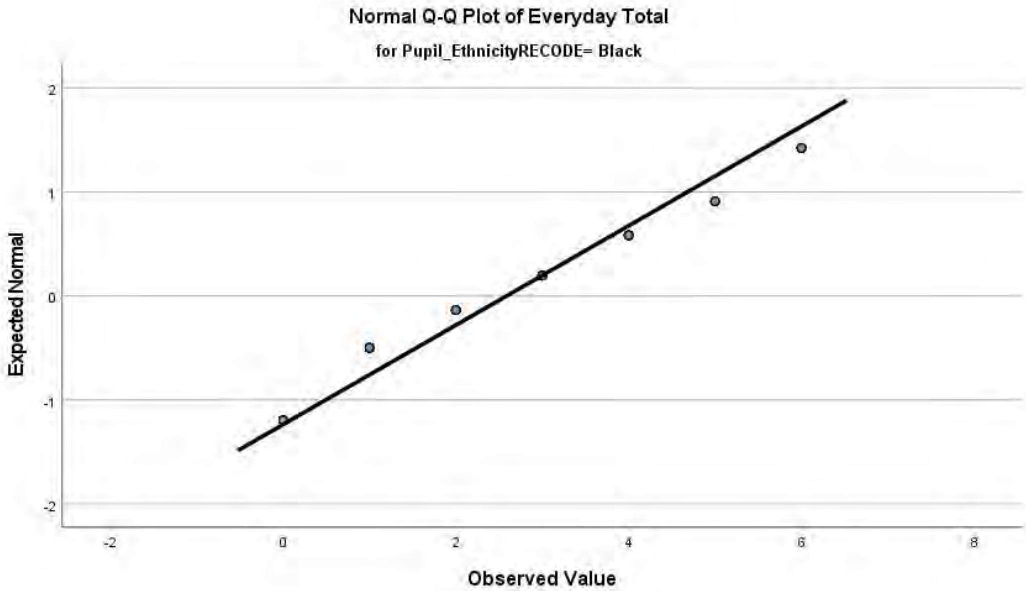
Test of Homogeneity of Variance

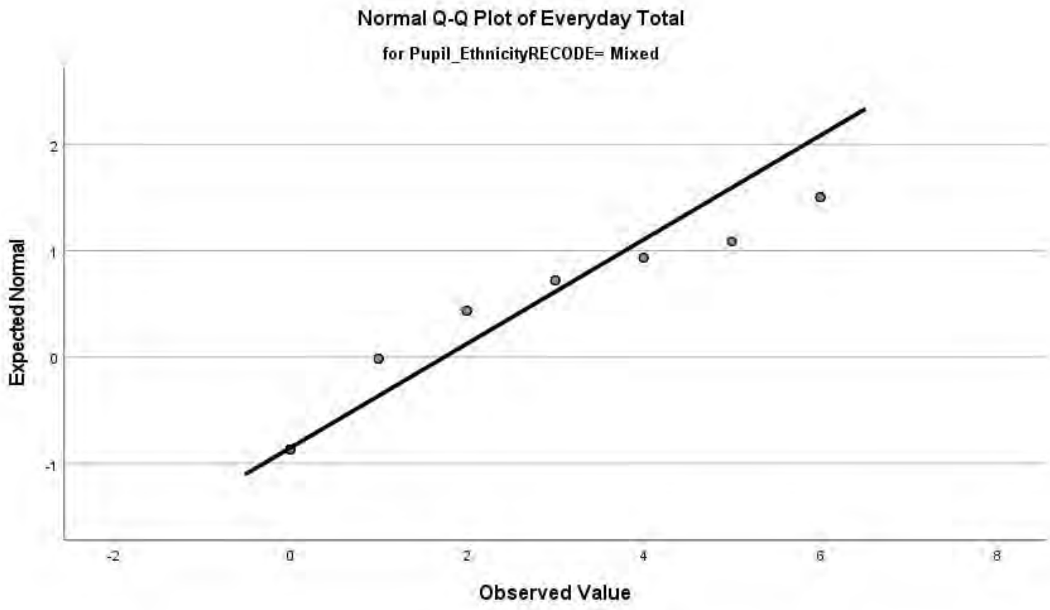
		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	4.323	4	1540	.002
	Based on Median	4.157	4	1540	.002
	Based on Median and with adjusted df	4.157	4	1473.539	.002
	Based on trimmed mean	4.434	4	1540	.001






Normal Q-Q Plot of Everyday Total
for Pupil_EthnicityRECODE= Chinese
Expected Normal
Observed Value
2
1
0
-1
-2
-2
0
2
4
6
8


Normal Q-Q Plot of Everyday Total
for Pupil_EthnicityRECODE= Black
Expected Normal
Observed Value
2
1
0
-1
-2
-2
0
2
4
6
8



Ethnicity output

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of Everyday Total is the same across categories of What is your ethnicity?.	Independent-Samples Kruskal-Wallis Test	<.001	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Independent-Samples Kruskal-Wallis Test Summary

Total N	1545
Test Statistic	40.517[a]
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	<.001

a. The test statistic is adjusted for ties.

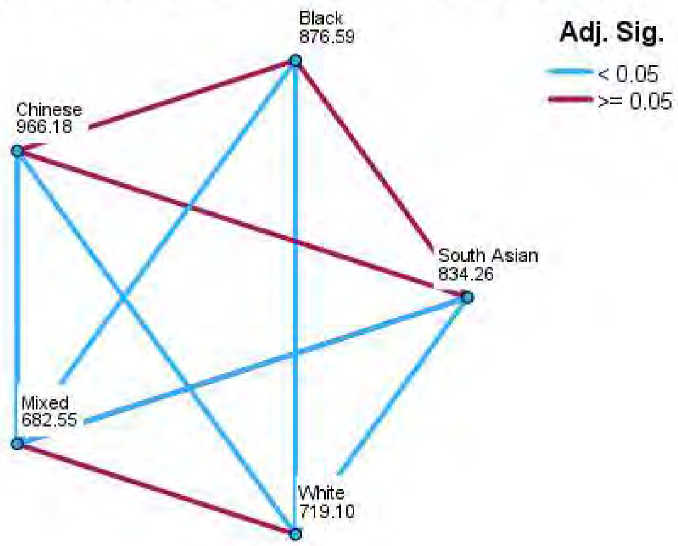
Pairwise Comparisons of What is your ethnicity?

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
Mixed-White	36.540	50.660	.721	.471	1.000
Mixed-South Asian	151.704	52.498	2.890	.004	.039
Mixed-Black	194.035	58.957	3.291	<.001	.010
Mixed-Chinese	283.627	90.134	3.147	.002	.017
White-South Asian	-115.164	25.689	-4.483	<.001	.000
White-Black	-157.494	37.146	-4.240	<.001	.000
White-Chinese	-247.086	77.640	-3.182	.001	.015
South Asian-Black	-42.331	39.617	-1.069	.285	1.000
South Asian-Chinese	-131.923	78.852	-1.673	.094	.943
Black-Chinese	89.592	83.292	1.076	.282	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Pairwise Comparisons of What is your ethnicity?



Each node shows the sample average rank of What is your ethnicity?.

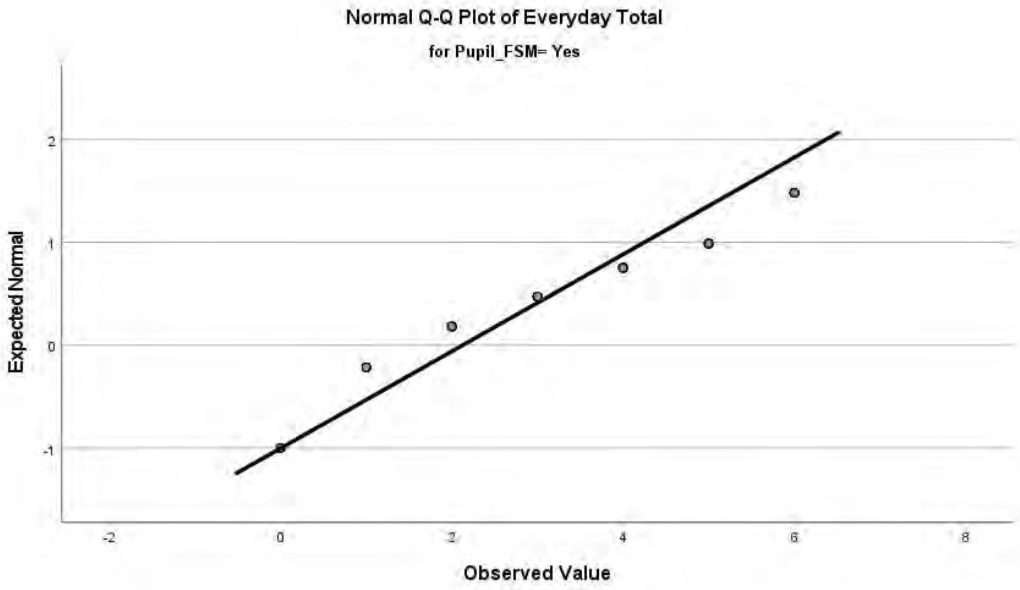
Free school meals parametric assumptions

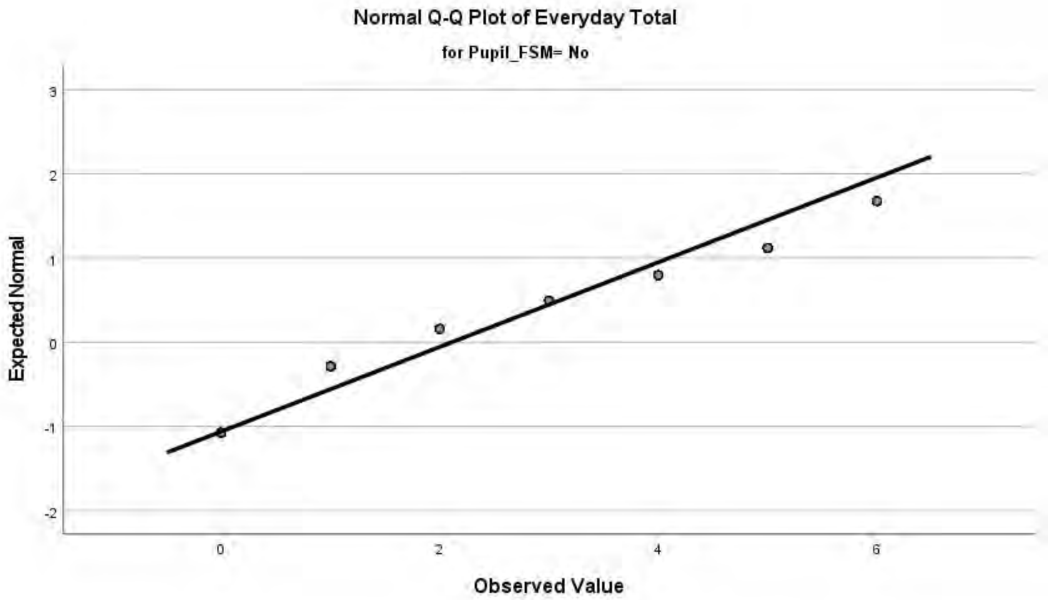
Descriptives

	Do you have free school meals?			Statistic	Std. Error
Everyday Total	Yes	Mean		2.1272	.09317
		95% Confidence Interval for Mean	Lower Bound	1.9441	
			Upper Bound	2.3102	
		5% Trimmed Mean		2.0302	
		Median		1.0000	
		Variance		4.505	
		Std. Deviation		2.12251	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.669	.107
		Kurtosis		-.925	.214
	No	Mean		2.1074	.05879
		95% Confidence Interval for Mean	Lower Bound	1.9921	
			Upper Bound	2.2228	
		5% Trimmed Mean		2.0082	
		Median		2.0000	
		Variance		3.958	
		Std. Deviation		1.98944	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.641	.072
		Kurtosis		-.846	.144

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	5.652	1	1662	.018
	Based on Median	2.164	1	1662	.142
	Based on Median and with adjusted df	2.164	1	1427.986	.142
	Based on trimmed mean	5.302	1	1662	.021





Free school meals output

Ranks

	Do you have free school meals?	N	Mean Rank	Sum of Ranks
Everyday Total	Yes	519	826.30	428849.50
	No	1145	835.31	956430.50
	Total	1664		

Test Statistics[a]

	Everyday Total
Mann-Whitney U	293909.500
Wilcoxon W	428849.500
Z	-.362
Asymp. Sig. (2-tailed)	.718

a. Grouping Variable: Do you have free school meals?

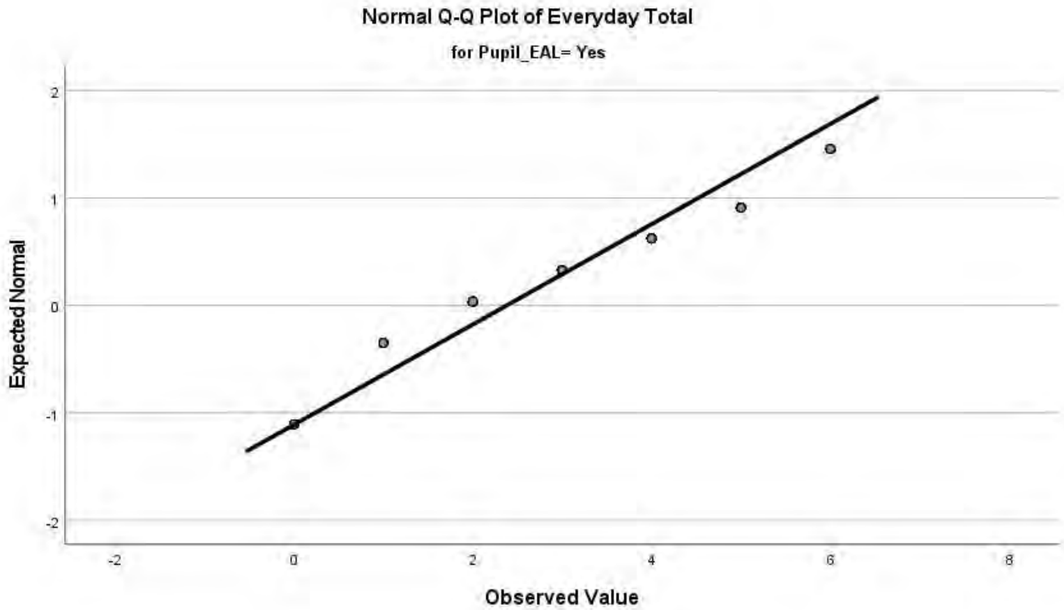
English as an additional language parametric assumption

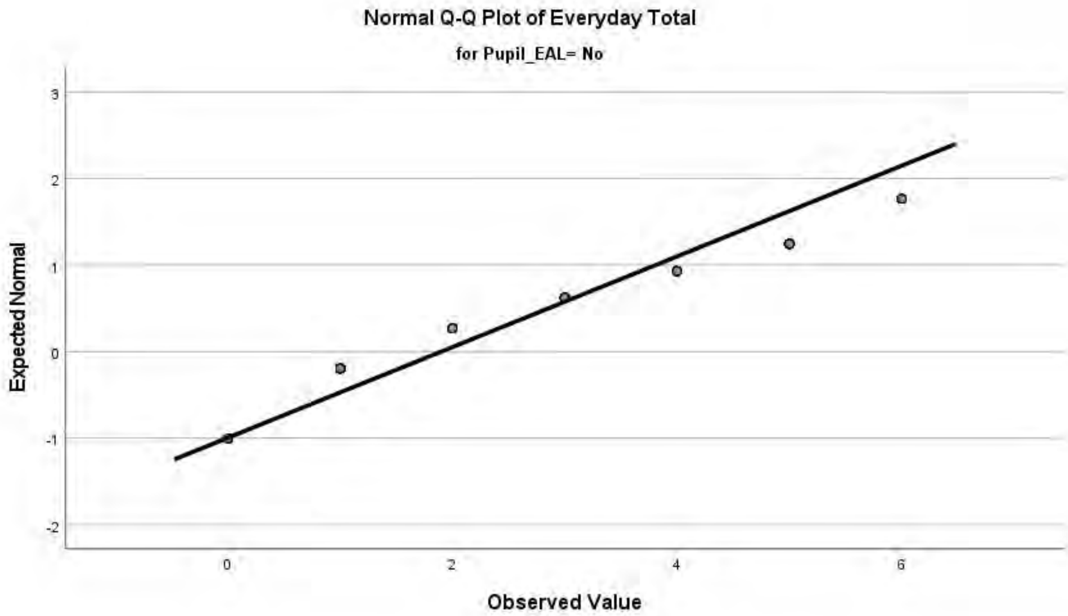
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
Everyday Total	Yes	Mean		2.3794	.08006
		95% Confidence Interval for Mean	Lower Bound	2.2222	
			Upper Bound	2.5365	
		5% Trimmed Mean		2.3104	
		Median		2.0000	
		Variance		4.596	
		Std. Deviation		2.14385	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.458	.091
		Kurtosis		-1.187	.182
	No	Mean		1.8978	.06195
		95% Confidence Interval for Mean	Lower Bound	1.7762	
			Upper Bound	2.0194	
		5% Trimmed Mean		1.7753	
		Median		1.0000	
		Variance		3.642	
		Std. Deviation		1.90853	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.807	.079
		Kurtosis		-.506	.159

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	34.264	1	1664	<.001
	Based on Median	21.115	1	1664	<.001
	Based on Median and with adjusted df	21.115	1	1598.308	<.001
	Based on trimmed mean	32.591	1	1664	<.001





English as an additional language output

Ranks

	Do you speak English as an additional language?	N	Mean Rank	Sum of Ranks
Everyday Total	Yes	717	889.92	638070.00
	No	949	790.88	750541.00
	Total	1666		

Test Statistics[a]

	Everyday Total
Mann-Whitney U	299766.000
Wilcoxon W	750541.000
Z	-4.246
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Do you speak English as an additional language?

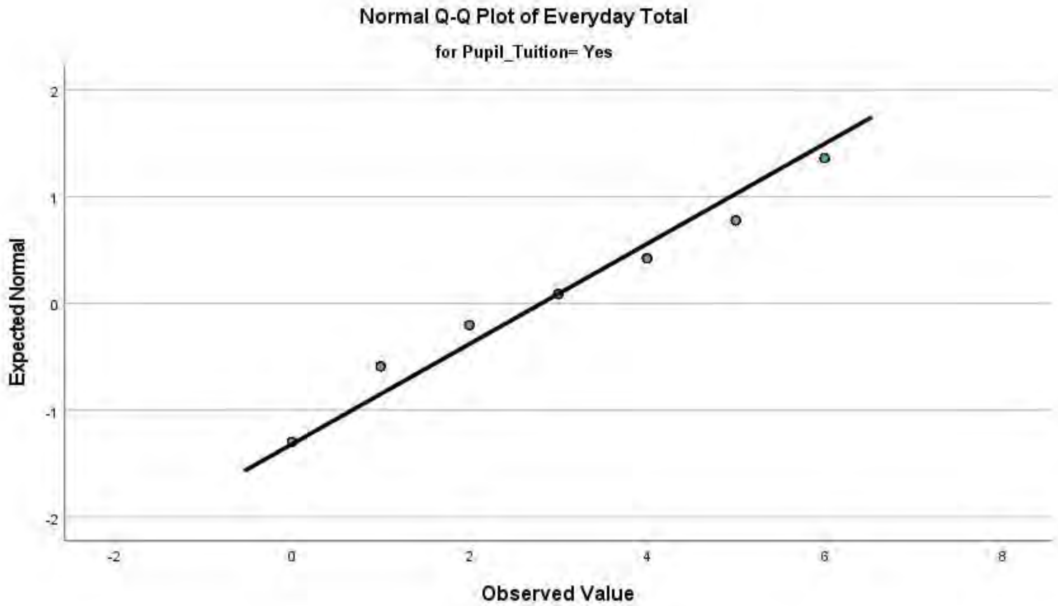
Extra maths tuition parametric assumptions

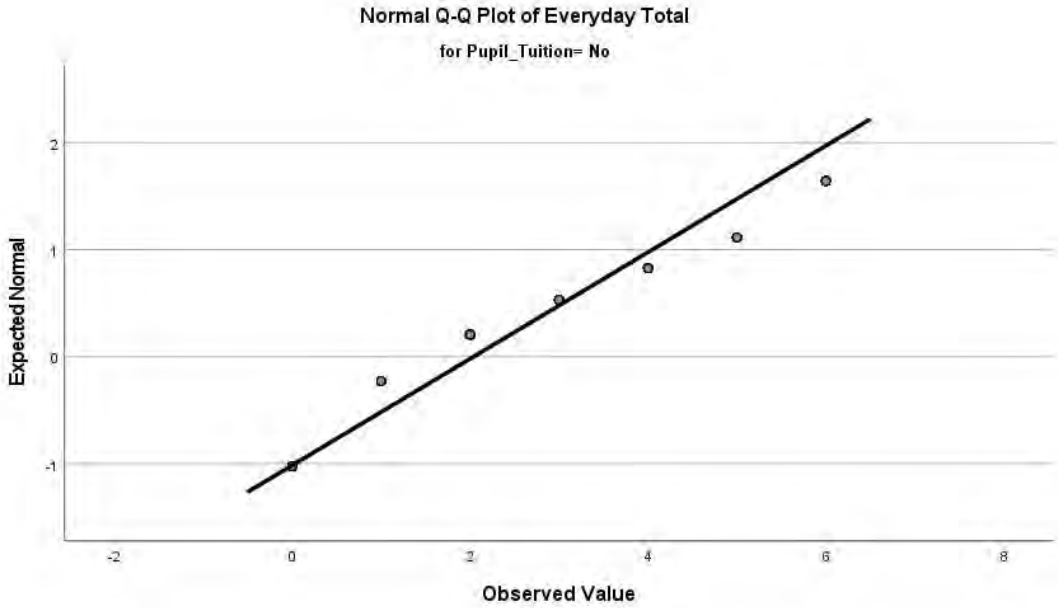
Descriptives

	Do you have extra maths tuition outside of school?			Statistic	Std. Error
Everyday Total	Yes	Mean		2.8112	.17835
		95% Confidence Interval for Mean	Lower Bound	2.4586	
			Upper Bound	3.1638	
		5% Trimmed Mean		2.7902	
		Median		3.0000	
		Variance		4.549	
		Std. Deviation		2.13275	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.149	.203
		Kurtosis		-1.358	.403
	No	Mean		2.0398	.05129
		95% Confidence Interval for Mean	Lower Bound	1.9392	
			Upper Bound	2.1404	
		5% Trimmed Mean		1.9331	
		Median		1.0000	
		Variance		4.033	
		Std. Deviation		2.00824	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.711	.063
		Kurtosis		-.764	.125

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	3.907	1	1674	,048
	Based on Median	2.726	1	1674	,099
	Based on Median and with adjusted df	2.726	1	1631.613	,099
	Based on trimmed mean	4.357	1	1674	,037





Extra maths tuition output

Ranks

	Do you have extra maths tuition outside of school?	N	Mean Rank	Sum of Ranks
Everyday Total	Yes	143	999.05	142864.50
	No	1533	823.52	1262461.50
	Total	1676		

Test Statistics[a]

	Everyday Total
Mann-Whitney U	86650.500
Wilcoxon W	1262461.500
Z	-4.234
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Do you have extra maths tuition outside of school?

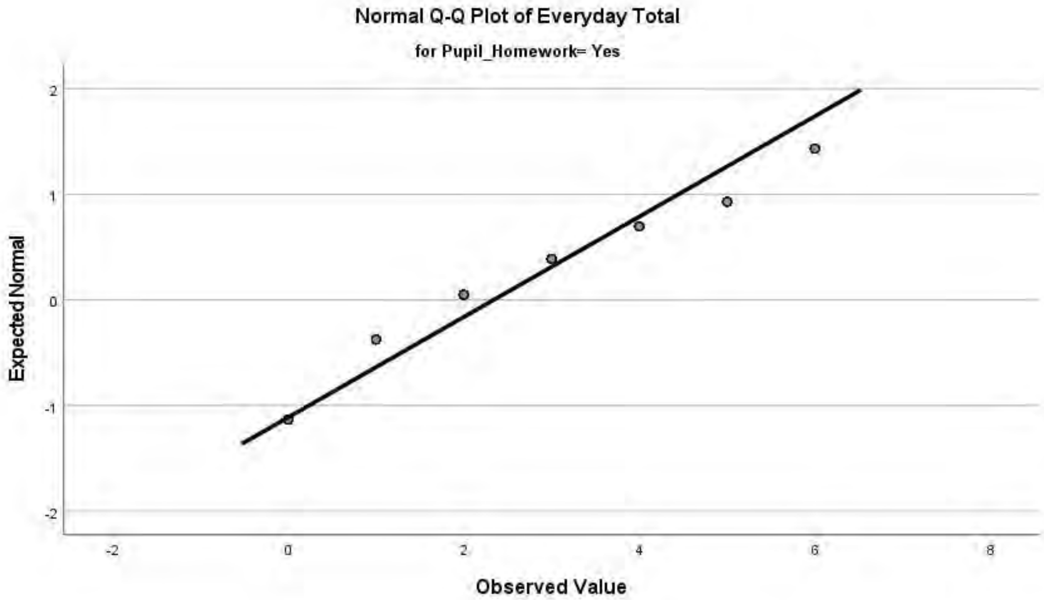
Parents help with homework parametric assumptions

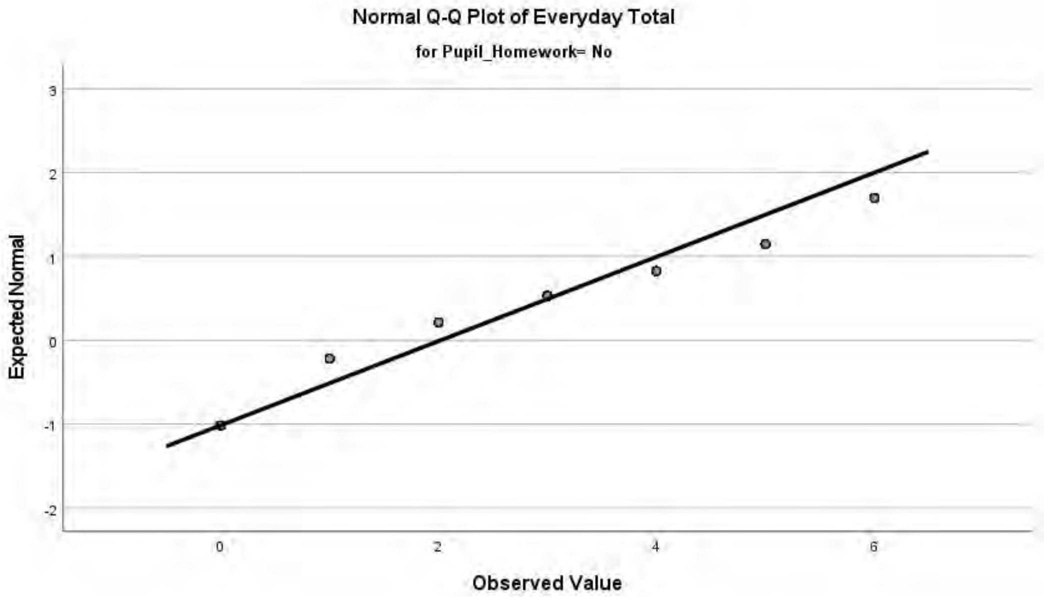
Descriptives

	Do your parents help you with your maths homework?			Statistic	Std. Error
Everyday Total	Yes	Mean		2.3396	.10187
		95% Confidence Interval for Mean	Lower Bound	2.1393	
			Upper Bound	2.5398	
		5% Trimmed Mean		2.2662	
		Median		2.0000	
		Variance		4.431	
		Std. Deviation		2.10508	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.538	.118
		Kurtosis		-1.032	.236
	No	Mean		2.0163	.05677
		95% Confidence Interval for Mean	Lower Bound	1.9049	
			Upper Bound	2.1276	
		5% Trimmed Mean		1.9070	
		Median		1.0000	
		Variance		3.964	
		Std. Deviation		1.99096	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.702	.070
		Kurtosis		-.779	.139

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	5.105	1	1655	.024
	Based on Median	2.114	1	1655	.146
	Based on Median and with adjusted df	2.114	1	1603.925	.146
	Based on trimmed mean	4.598	1	1655	.032





Parents help with homework output

Ranks

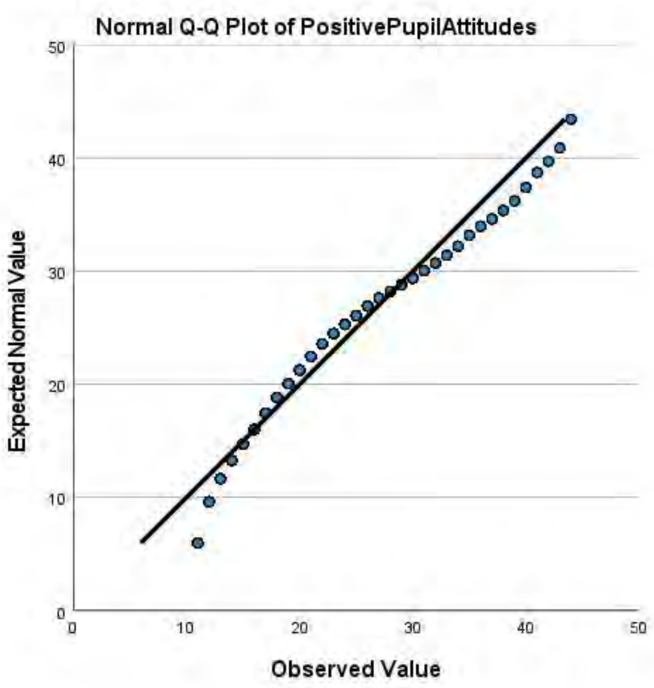
	Do your parents help you with your maths homework?	N	Mean Rank	Sum of Ranks
Everyday Total	Yes	427	883.81	377389.00
	No	1230	809.97	996264.00
	Total	1657		

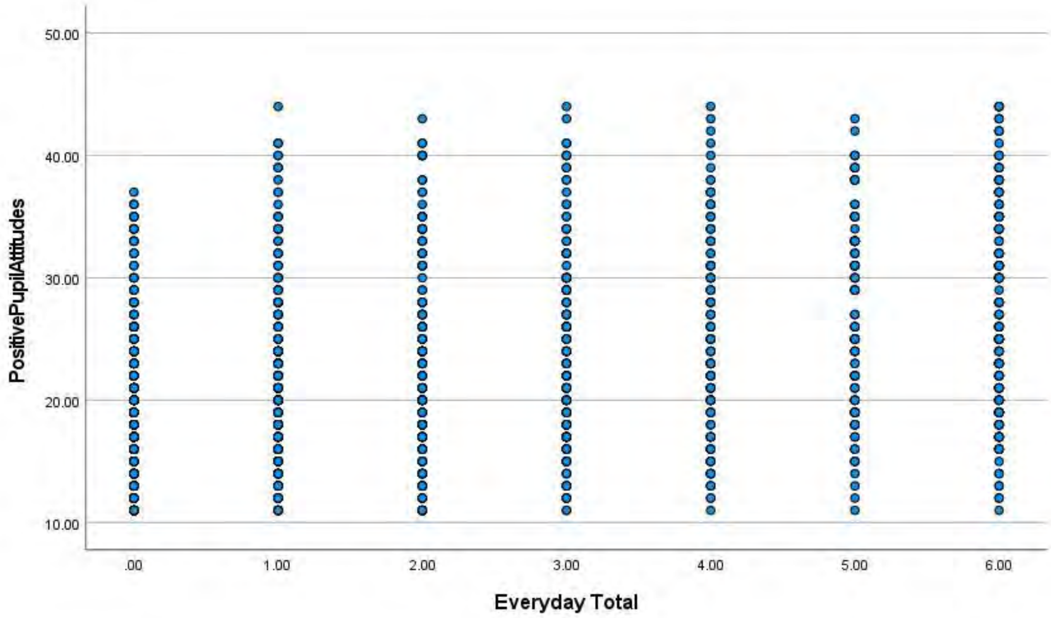
Test Statistics[a]

	Everyday Total
Mann-Whitney U	239199.000
Wilcoxon W	996264.000
Z	-2.805
Asymp. Sig. (2-tailed)	.005

a. Grouping Variable: Do your parents help you with your maths homework?

Pupils attitudes parametric assumptions





Pupils’ attitudes output

Correlations

			PositivePupilAttitudes	Everyday Total
Spearman's rho	PositivePupilAttitudes	Correlation Coefficient	1.000	.345**
		Sig. (2-tailed)	.	<.001
		N	1605	1601
	Everyday Total	Correlation Coefficient	.345**	1.000
		Sig. (2-tailed)	<.001	.
		N	1601	1692

**. Correlation is significant at the 0.01 level (2-tailed).

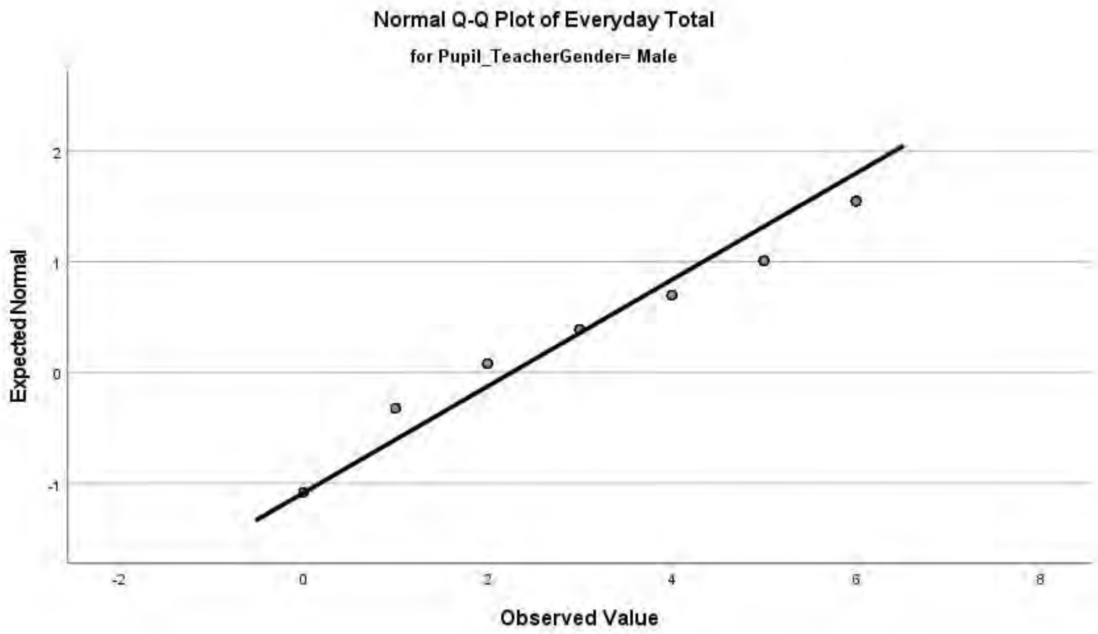
Teacher gender parametric assumptions

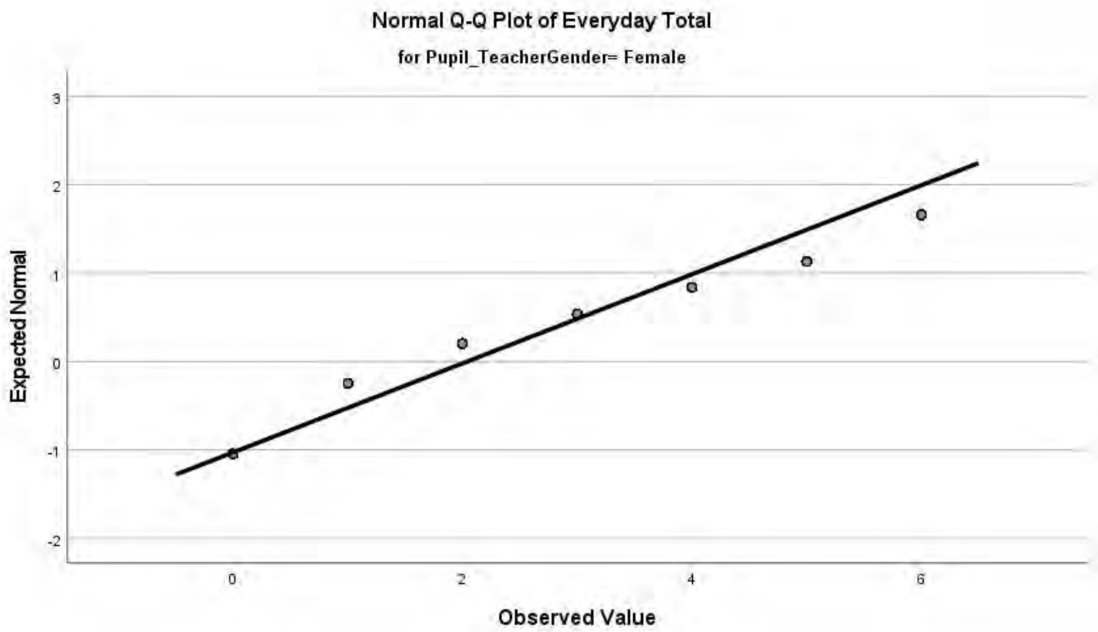
Descriptives

	Is your maths teacher male or female?			Statistic	Std. Error
Everyday Total	Male	Mean		2.2594	.08217
		95% Confidence Interval for Mean	Lower Bound	2.0980	
			Upper Bound	2.4207	
		5% Trimmed Mean		2.1771	
		Median		2.0000	
		Variance		4.321	
		Std. Deviation		2.07864	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.529	.097
		Kurtosis		-1.053	.193
	Female	Mean		2.0378	.06344
		95% Confidence Interval for Mean	Lower Bound	1.9133	
			Upper Bound	2.1623	
		5% Trimmed Mean		1.9308	
		Median		1.0000	
		Variance		3.944	
		Std. Deviation		1.98606	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.718	.078
		Kurtosis		-.726	.156

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	6.949	1	1618	.008
	Based on Median	3.196	1	1618	.074
	Based on Median and with adjusted df	3.196	1	1509.607	.074
	Based on trimmed mean	6.358	1	1618	.012





Teacher gender output

Ranks

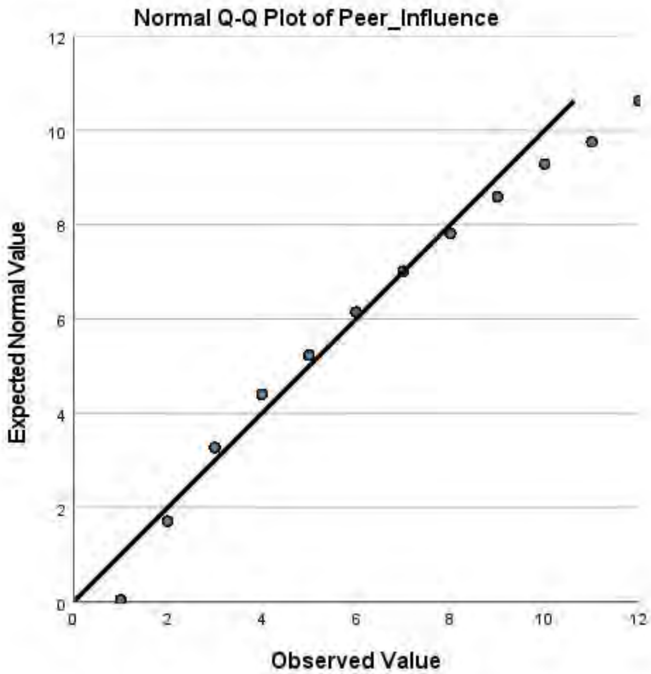
	Is your maths teacher male or female?	N	Mean Rank	Sum of Ranks
Everyday Total	Male	640	837.80	536191.50
	Female	980	792.67	776818.50
	Total	1620		

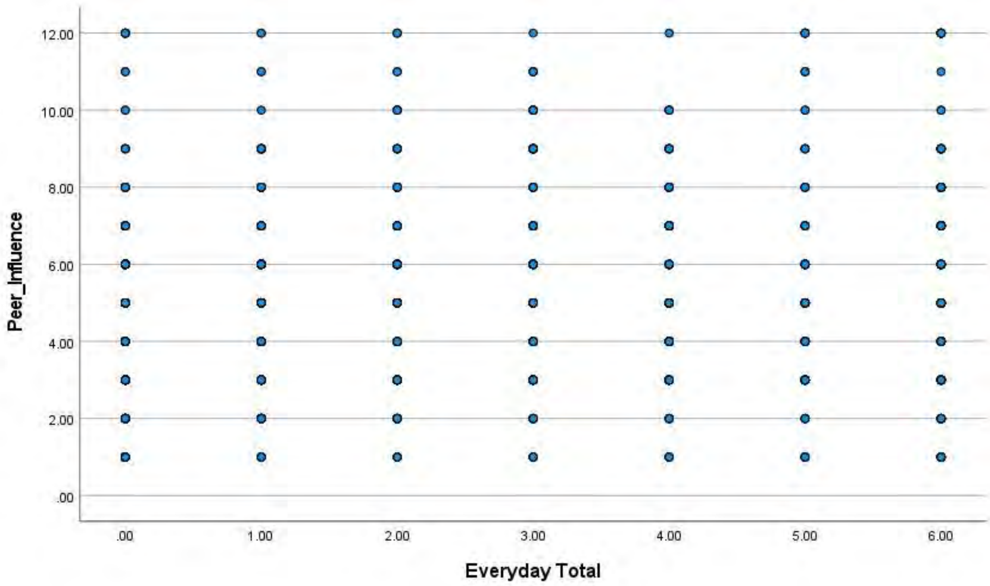
Test Statistics[a]

	Everyday Total
Mann-Whitney U	296128.500
Wilcoxon W	776818.500
Z	-1.936
Asymp. Sig. (2-tailed)	.053

a. Grouping Variable: Is your maths teacher male or female?

Peer attitudes parametric assumptions





Peer attitudes output

Correlations

			Everyday Total	Peer_Influence
Spearman's rho	Everyday Total	Correlation Coefficient	1.000	.186**
		Sig. (2-tailed)	.	<.001
		N	1692	1541
	Peer_Influence	Correlation Coefficient	.186**	1.000
		Sig. (2-tailed)	<.001	.
		N	1541	1545

**. Correlation is significant at the 0.01 level (2-tailed).

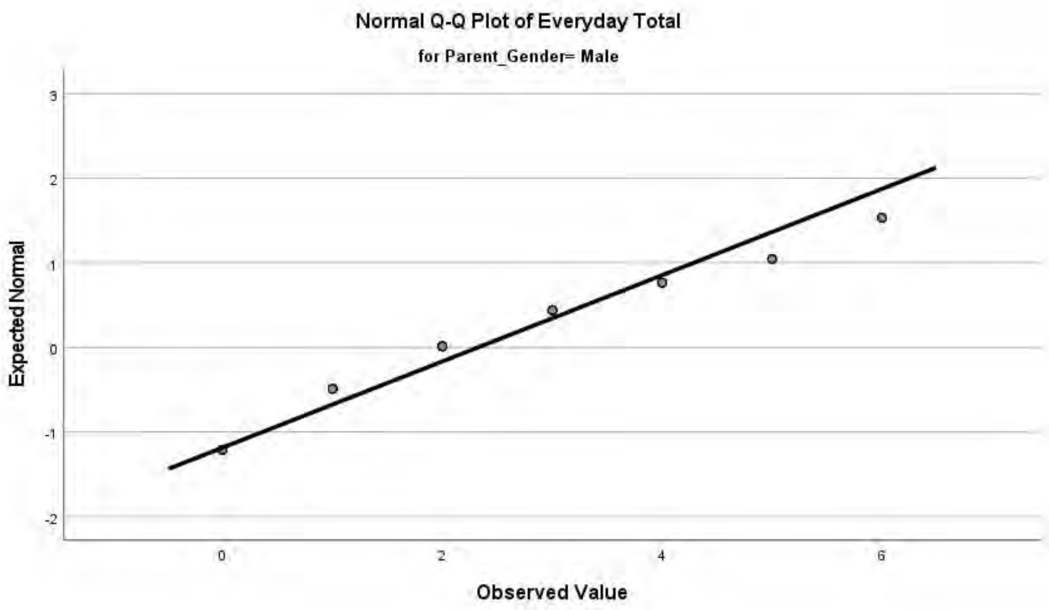
Parent gender parametric assumptions

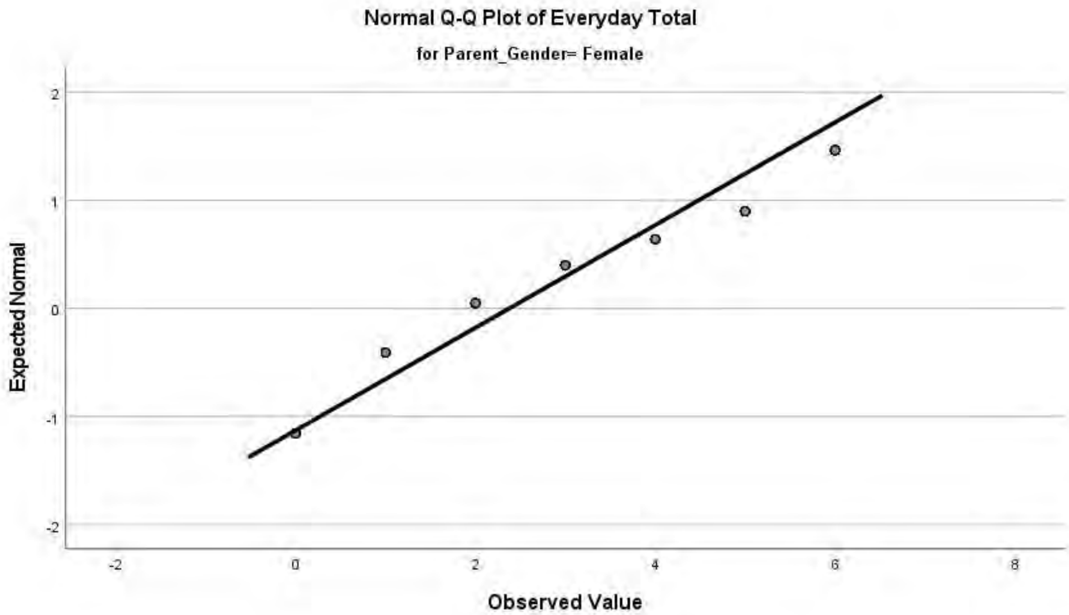
Descriptives

	What is your gender?			Statistic	Std. Error
Everyday Total	Male	Mean		2.3218	.21033
		95% Confidence Interval for Mean	Lower Bound	1.9037	
			Upper Bound	2.7400	
		5% Trimmed Mean		2.2465	
		Median		2.0000	
		Variance		3.849	
		Std. Deviation		1.96181	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.567	.258
		Kurtosis		-.789	.511
	Female	Mean		2.3755	.13920
		95% Confidence Interval for Mean	Lower Bound	2.1013	
			Upper Bound	2.6498	
		5% Trimmed Mean		2.3062	
		Median		2.0000	
		Variance		4.437	
		Std. Deviation		2.10649	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.515	.161
		Kurtosis		-1.091	.320

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	1.833	1	314	.177
	Based on Median	1.261	1	314	.262
	Based on Median and with adjusted df	1.261	1	313.892	.262
	Based on trimmed mean	1.787	1	314	.182





Parents gender output

Group Statistics

	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
Everyday Total	Male	87	2.3218	1.96181	.21033
	Female	229	2.3755	2.10649	.13920

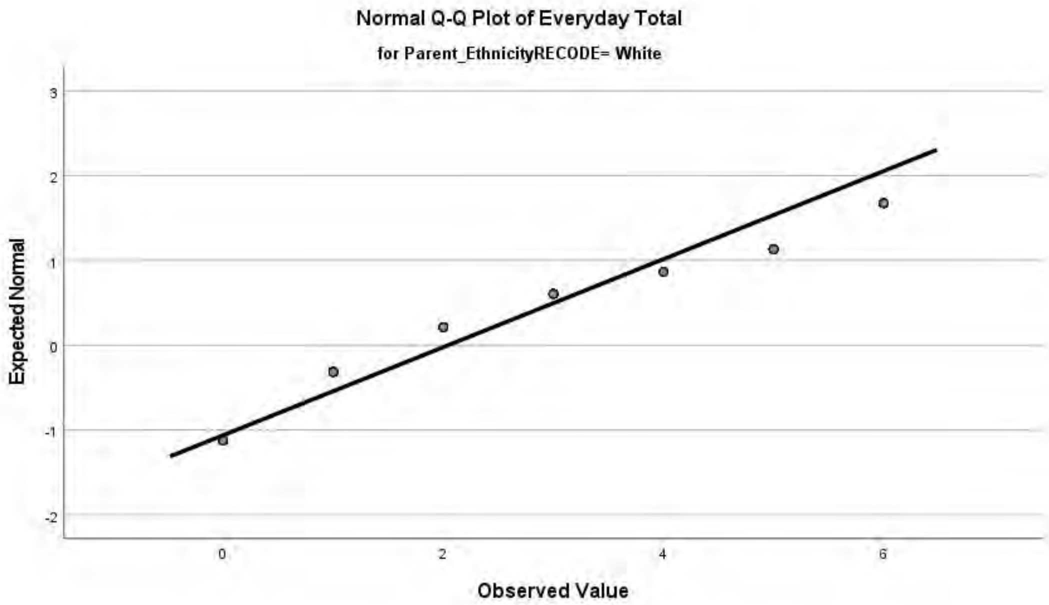
Independent Samples Test

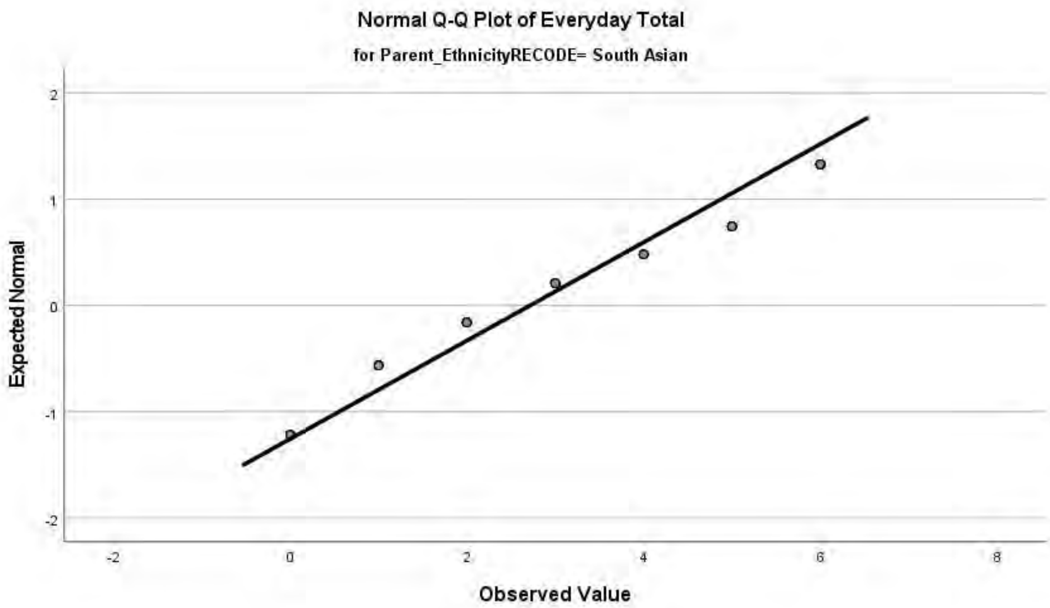
		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Everyday Total	Equal variances assumed	1.833	.177	-.206	314	.418	.837	-.05371	.26043	-.56611	.45870
	Equal variances not assumed			-.213	165.837	.416	.832	-.05371	.25222	-.55168	.44427

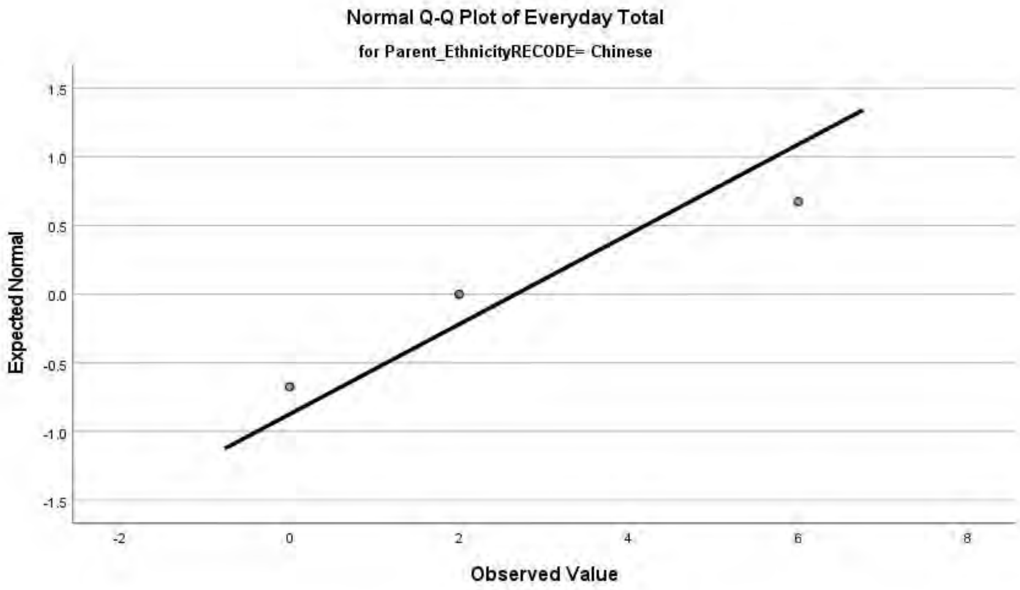
Parents ethnicity parametric assumptions

Descriptives

	What is your ethnicity?			Statistic	Std. Error
Everyday Total	White	Mean		2.0412	.14770
		95% Confidence Interval for Mean	Lower Bound	1.7496	
			Upper Bound	2.3327	
		5% Trimmed Mean		1.9346	
		Median		2.0000	
		Variance		3.708	
		Std. Deviation		1.92571	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.781	.186
		Kurtosis		-.540	.370
	South Asian	Mean		2.7157	.21422
		95% Confidence Interval for Mean	Lower Bound	2.2907	
			Upper Bound	3.1406	
		5% Trimmed Mean		2.6841	
		Median		2.0000	
		Variance		4.681	
		Std. Deviation		2.16350	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.256	.239
		Kurtosis		-1.312	.474
	Chinese	Mean		2.6667	1.76383
		95% Confidence Interval for Mean	Lower Bound	-4.9225	
			Upper Bound	10.2558	
		5% Trimmed Mean		.	
		Median		2.0000	
		Variance		9.333	
		Std. Deviation		3.05505	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		.	
		Skewness		.935	1.225
		Kurtosis		.	.
	Black	Mean		3.0000	.41879
		95% Confidence Interval for Mean	Lower Bound	2.1375	
			Upper Bound	3.8625	
		5% Trimmed Mean		3.0000	
		Median		3.0000	
		Variance		4.560	
		Std. Deviation		2.13542	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		4.00	
		Skewness		.053	.456
		Kurtosis		-1.356	.887
	Mixed	Mean		2.6250	.86474
		95% Confidence Interval for Mean	Lower Bound	.5802	
			Upper Bound	4.6698	
		5% Trimmed Mean		2.5833	
		Median		2.0000	
		Variance		5.982	
		Std. Deviation		2.44584	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		5.25	
		Skewness		.502	.752
		Kurtosis		-1.400	1.481


Normal Q-Q Plot of Everyday Total
for Parent_EthnicityRECODE= White
Expected Normal
Observed Value


Normal Q-Q Plot of Everyday Total
for Parent_EthnicityRECODE= South Asian
Expected Normal
Observed Value


Normal Q-Q Plot of Everyday Total
for Parent_EthnicityRECODE= Chinese
Expected Normal
Observed Value
1.5
1.0
0.5
0.0
-0.5
-1.0
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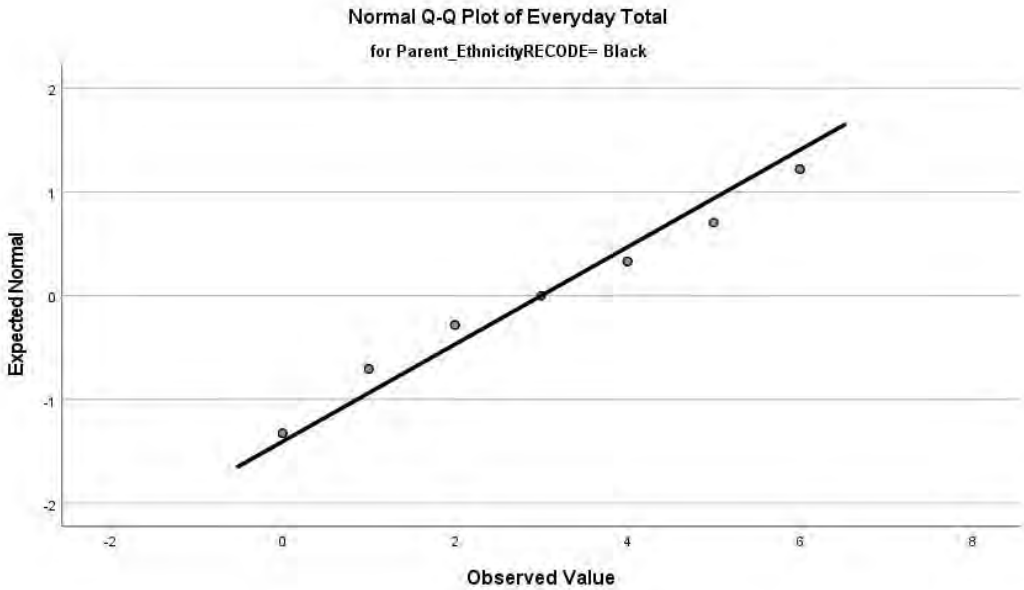
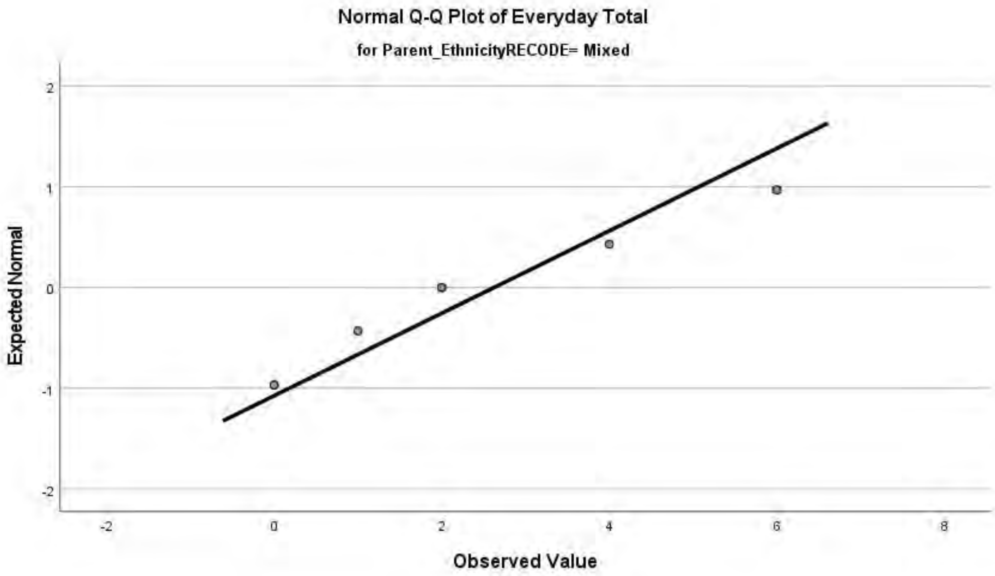
0
2
4
6
8


Normal Q-Q Plot of Everyday Total
for Parent_EthnicityRECODE= Black
Expected Normal
Observed Value
2
1
0
-1
-2
-2
0
2
4
6
8



Parents ethnicity output

Descriptives

Everyday Total

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
White	170	2.0412	1.92571	.14770	1.7496	2.3327	.00	6.00
South Asian	102	2.7157	2.16350	.21422	2.2907	3.1406	.00	6.00
Black	26	3.0000	2.13542	.41879	2.1375	3.8625	.00	6.00
Total	298	2.3557	2.05505	.11905	2.1214	2.5900	.00	6.00

ANOVA

Everyday Total

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	40.829	2	20.414	4.963	.008
Within Groups	1213.467	295	4.113		
Total	1254.295	297			

Multiple Comparisons

Dependent Variable: Everyday Total
Scheffe

(I) What is your ethnicity?	(J) What is your ethnicity?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
White	South Asian	-.67451*	.25402	.031	-1.2994	-.0496
	Black	-.95882	.42709	.082	-2.0096	.0919
South Asian	White	.67451*	.25402	.031	.0496	1.2994
	Black	-.28431	.44558	.816	-1.3805	.8119
Black	White	.95882	.42709	.082	-.0919	2.0096
	South Asian	.28431	.44558	.816	-.8119	1.3805

*. The mean difference is significant at the 0.05 level.

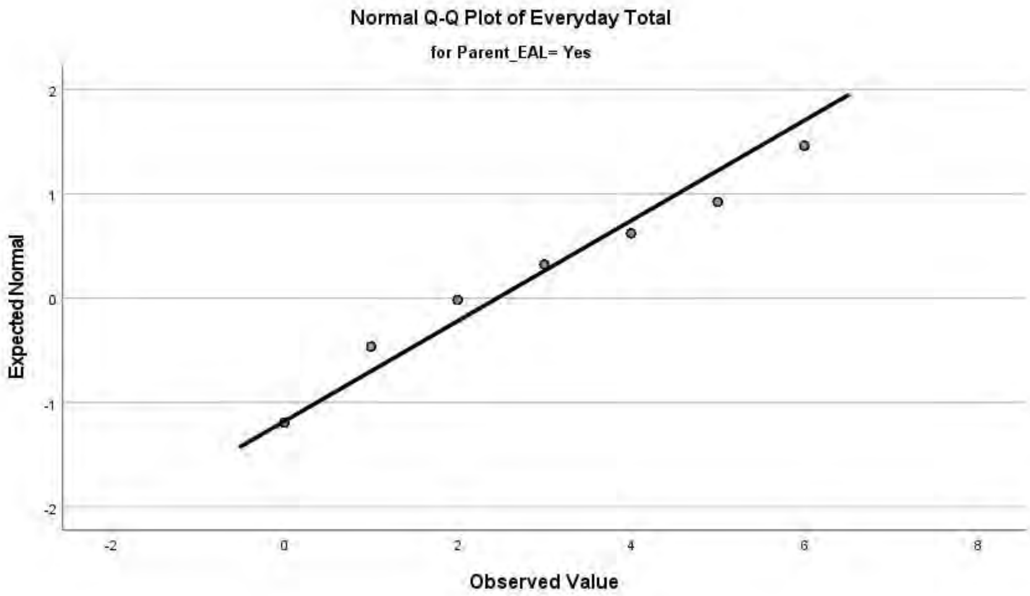
Parents English as an Additional Language parametric assumptions

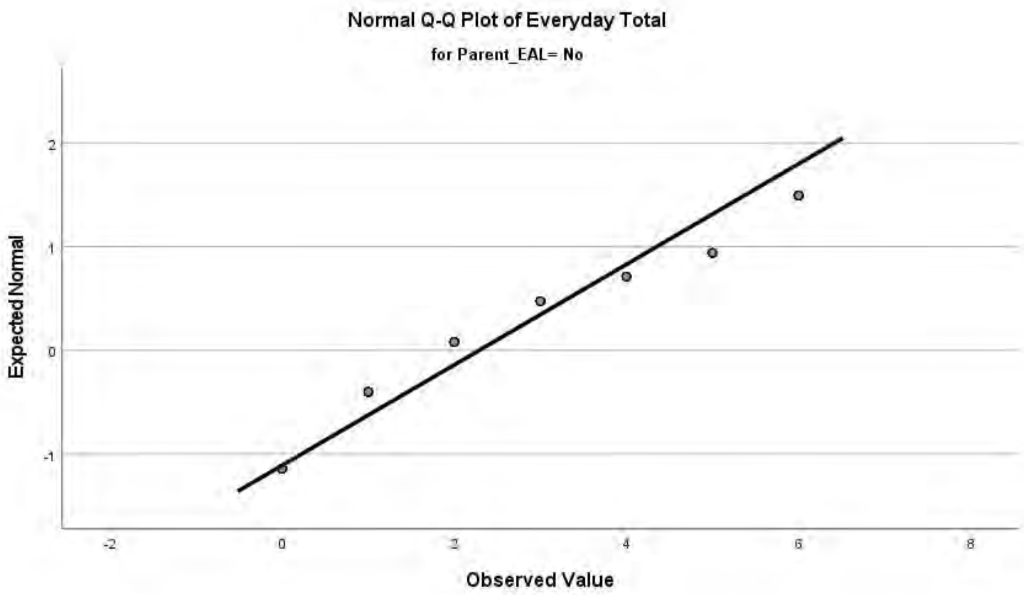
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
Everyday Total	Yes	Mean		2.4552	.17287
		95% Confidence Interval for Mean	Lower Bound	2.1135	
			Upper Bound	2.7969	
		5% Trimmed Mean		2.3946	
		Median		2.0000	
		Variance		4.333	
		Std. Deviation		2.08160	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.00	
		Skewness		.434	.201
		Kurtosis		-1.125	.400
	No	Mean		2.2899	.15867
		95% Confidence Interval for Mean	Lower Bound	1.9767	
			Upper Bound	2.6032	
		5% Trimmed Mean		2.2110	
		Median		2.0000	
		Variance		4.255	
		Std. Deviation		2.06270	
		Minimum		.00	
		Maximum		6.00	
		Range		6.00	
		Interquartile Range		3.50	
		Skewness		.601	.187
		Kurtosis		-.928	.371

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Everyday Total	Based on Mean	.309	1	312	.579
	Based on Median	.288	1	312	.592
	Based on Median and with adjusted df	.288	1	311.889	.592
	Based on trimmed mean	.402	1	312	.527





Parents English as an Additional Language output

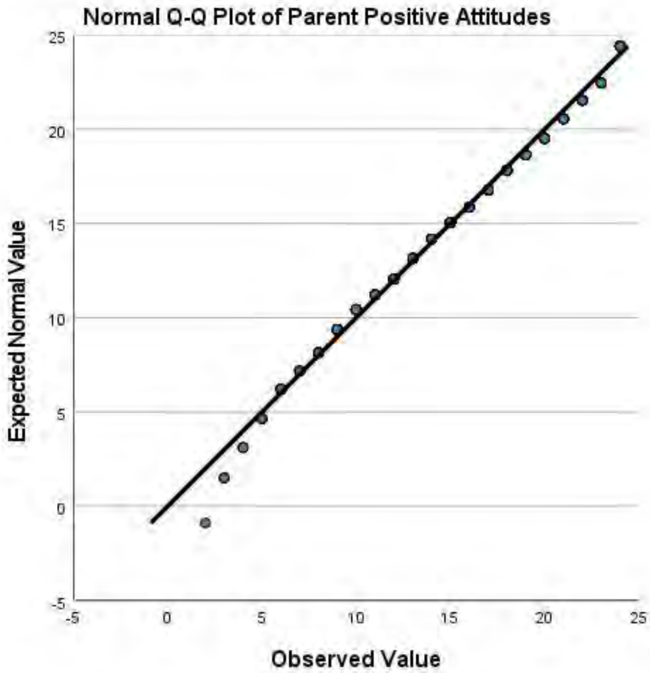
Group Statistics

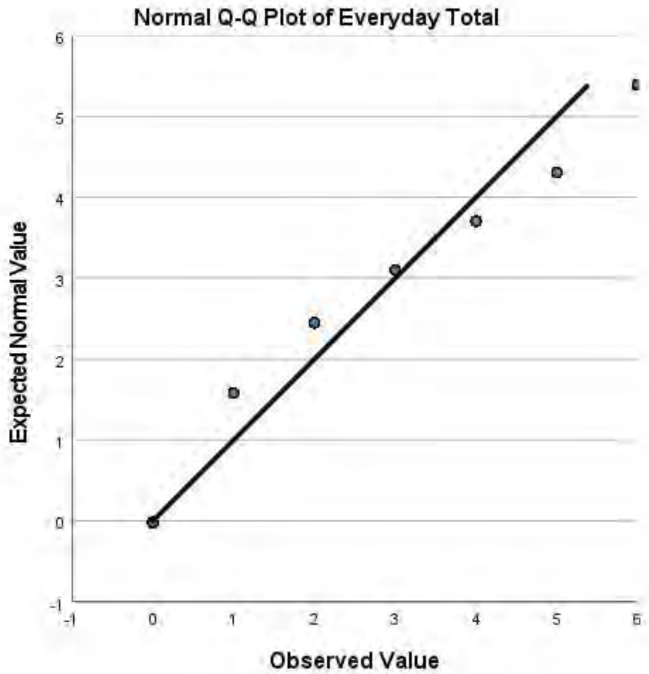
	Do you speak English as an additional language?	N	Mean	Std. Deviation	Std. Error Mean
Everyday Total	Yes	145	2.4552	2.08160	.17287
	No	169	2.2899	2.06270	.15867

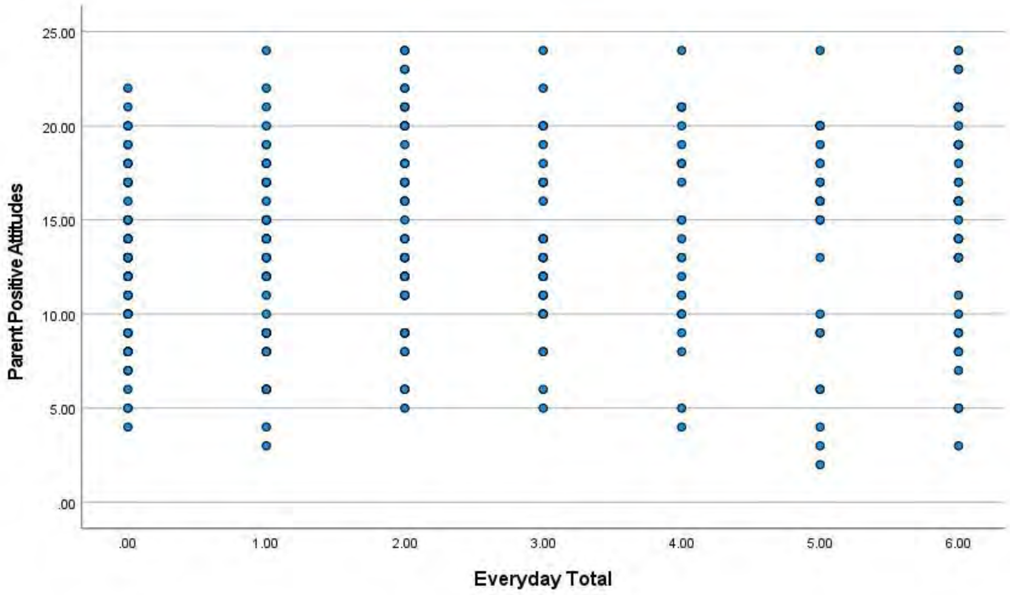
Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Everyday Total	Equal variances assumed	.309	.579	.705	312	.241	.482	.16523	.23448	-.29614	.62660
	Equal variances not assumed			.704	303.935	.241	.482	.16523	.23465	-.29651	.62697

Parents attitudes parametric assumptions







Parents attitudes output

Correlations

			Everyday Total	Parent Positive Attitudes
Spearman's rho	Everyday Total	Correlation Coefficient	1.000	.160**
		Sig. (2-tailed)	.	.005
		N	1692	310
	Parent Positive Attitudes	Correlation Coefficient	.160**	1.000
		Sig. (2-tailed)	.005	.
		N	310	368

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix E.4: Confidence

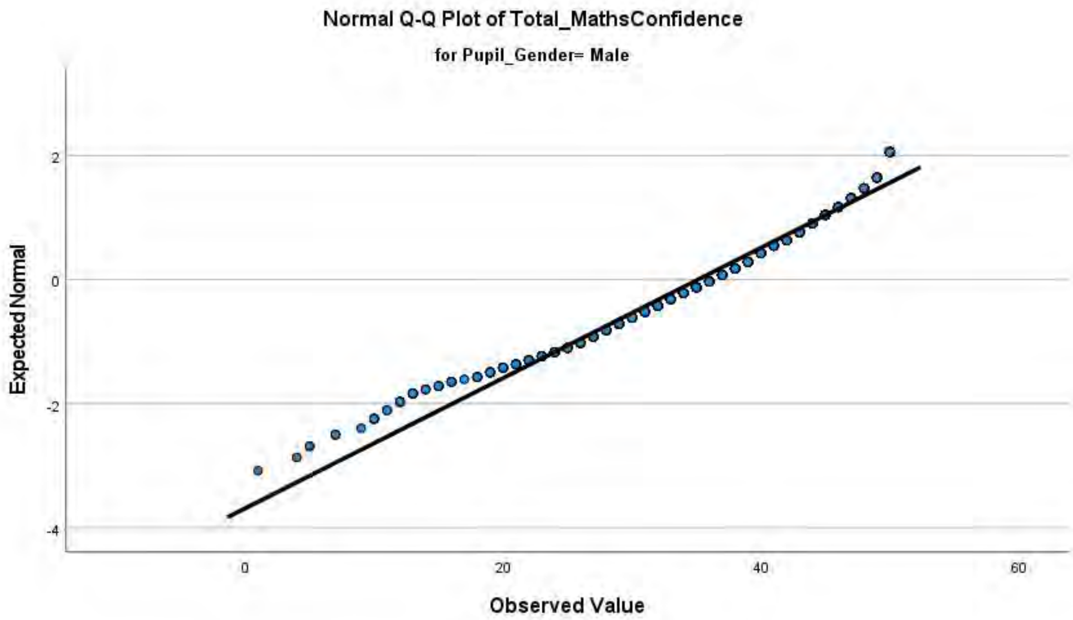
Gender parametric assumptions

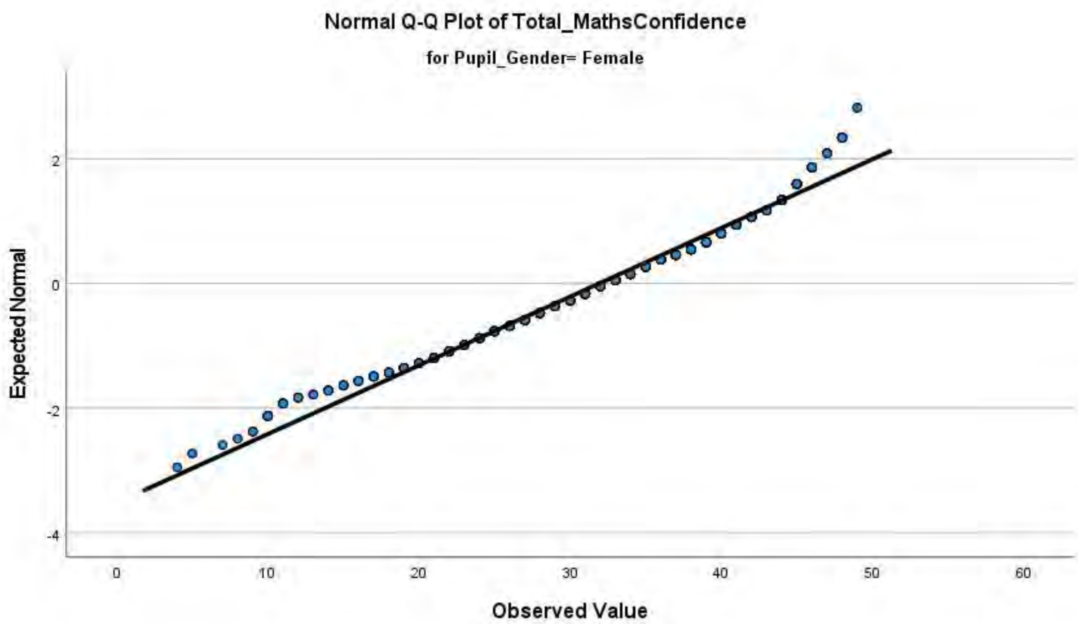
Descriptives

	What is your gender?			Statistic	Std. Error
Total_MathsConfidence	Male	Mean		35.1115	.30748
		95% Confidence Interval for Mean	Lower Bound	34.5081	
			Upper Bound	35.7149	
		5% Trimmed Mean		35.6053	
		Median		36.0000	
		Variance		90.760	
		Std. Deviation		9.52682	
		Minimum		1.00	
		Maximum		50.00	
		Range		49.00	
		Interquartile Range		13.00	
		Skewness		-.684	.079
		Kurtosis		.237	.158
	Female	Mean		31.9152	.36304
		95% Confidence Interval for Mean	Lower Bound	31.2023	
			Upper Bound	32.6281	
		5% Trimmed Mean		32.2649	
		Median		32.0000	
		Variance		82.376	
		Std. Deviation		9.07611	
		Minimum		4.00	
		Maximum		49.00	
		Range		45.00	
		Interquartile Range		13.00	
		Skewness		-.455	.098
		Kurtosis		-.212	.195

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Total_MathsConfidence	Based on Mean	.845	1	1583	.358
	Based on Median	.523	1	1583	.470
	Based on Median and with adjusted df	.523	1	1569.774	.470
	Based on trimmed mean	.665	1	1583	.415





Gender output

Group Statistics

	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Male	952	42.5137	11.06495	.35862
	Female	621	38.8100	10.56833	.42409

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	1.208	.272	6.604	1571	<.001	<.001	3.70367	.56078	2.60371	4.80364
	Equal variances not assumed			6.669	1367.749	<.001	<.001	3.70367	.55539	2.61416	4.79318

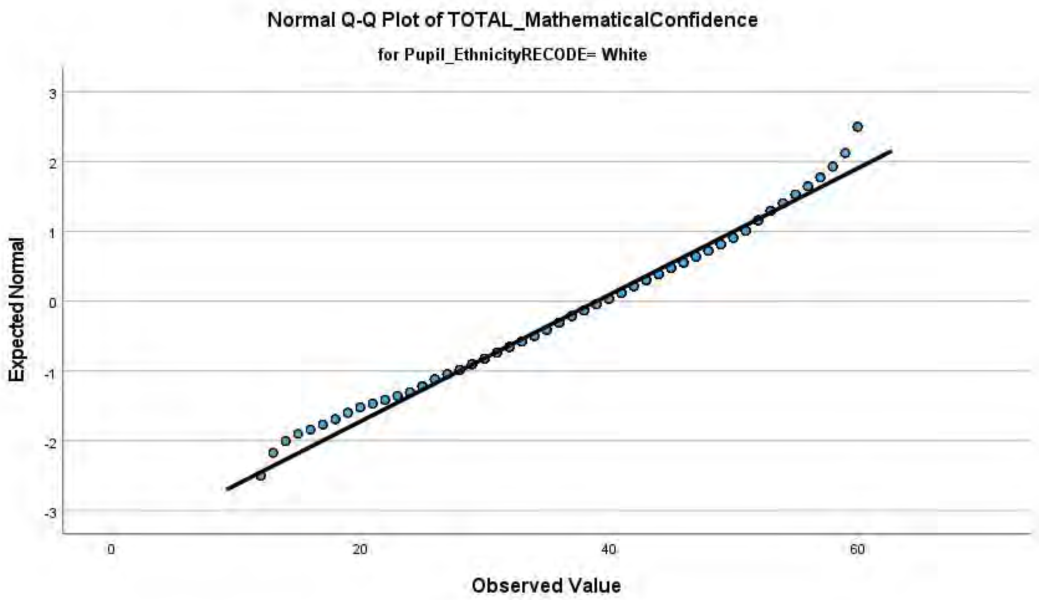
Ethnicity parametric assumptions

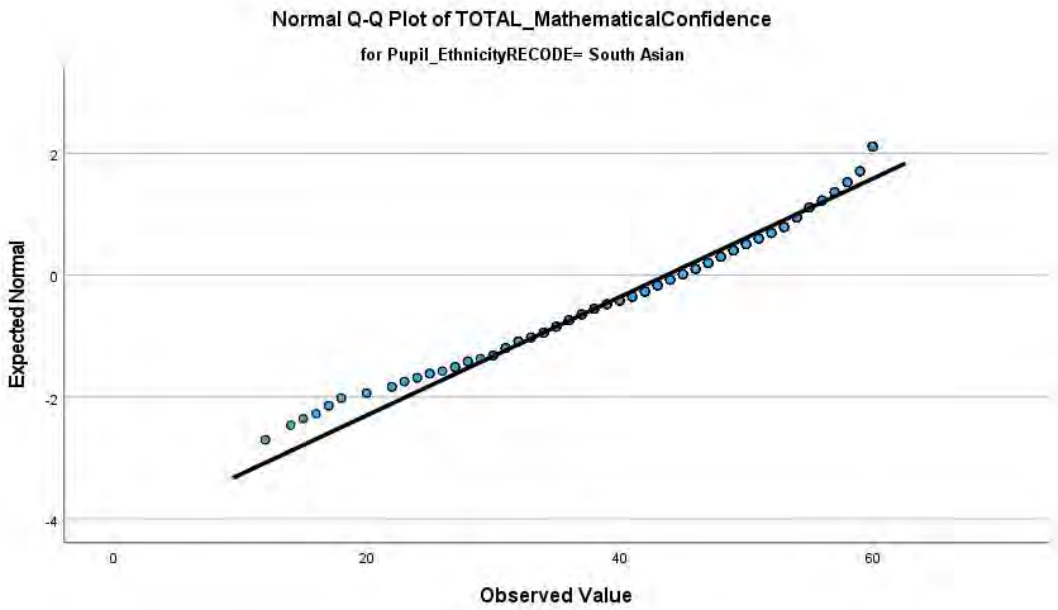
Descriptives

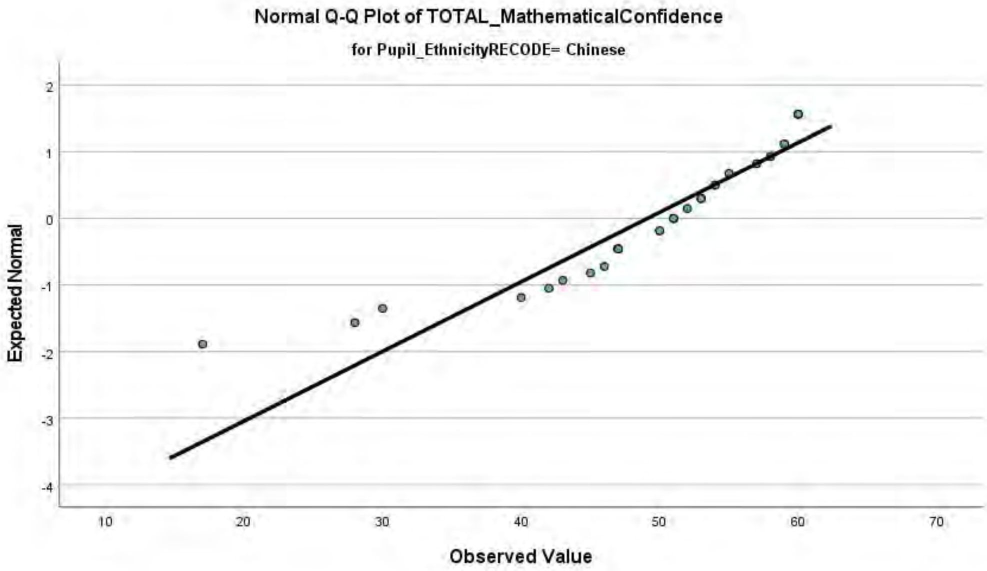
	What is your ethnicity?			Statistic	Std. Error
TOTAL_MathematicalConfidence	White	Mean		39.0088	.39018
		95% Confidence Interval for Mean	Lower Bound	38.2429	
			Upper Bound	39.7747	
		5% Trimmed Mean		39.2904	
		Median		40.0000	
		Variance		121.640	
		Std. Deviation		11.02906	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.00	
		Skewness		-.324	.086
		Kurtosis		-.411	.173
	South Asian	Mean		43.6868	.49599
		95% Confidence Interval for Mean	Lower Bound	42.7119	
			Upper Bound	44.6616	
		5% Trimmed Mean		44.1552	
		Median		45.0000	
		Variance		106.030	
		Std. Deviation		10.29707	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.00	
		Skewness		-.574	.118
		Kurtosis		-.054	.235
	Chinese	Mean		49.1212	1.66785
		95% Confidence Interval for Mean	Lower Bound	45.7239	
			Upper Bound	52.5185	
		5% Trimmed Mean		50.0606	
		Median		51.0000	
		Variance		91.797	
		Std. Deviation		9.58109	
		Minimum		17.00	
		Maximum		60.00	
		Range		43.00	
		Interquartile Range		8.50	
		Skewness		-1.634	.409
		Kurtosis		3.337	.798
	Black	Mean		42.1132	.85559
		95% Confidence Interval for Mean	Lower Bound	40.4233	
			Upper Bound	43.8031	
		5% Trimmed Mean		42.5992	
		Median		43.0000	
		Variance		116.392	
		Std. Deviation		10.78852	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.00	
		Skewness		-.622	.192
		Kurtosis		.030	.383
	Mixed	Mean		39.0260	1.37475
		95% Confidence Interval for Mean	Lower Bound	36.2879	
			Upper Bound	41.7640	
		5% Trimmed Mean		39.4812	
		Median		41.0000	
		Variance		145.526	
		Std. Deviation		12.06340	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		16.50	
		Skewness		-.540	.274
		Kurtosis		-.332	.541

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	2.152	4	1494	.072
	Based on Median	2.307	4	1494	.056
	Based on Median and with adjusted df	2.307	4	1487.064	.056
	Based on trimmed mean	2.337	4	1494	.053






Normal Q-Q Plot of TOTAL_MathematicalConfidence
for Pupil_EthnicityRECODE= Chinese
Expected Normal
Observed Value
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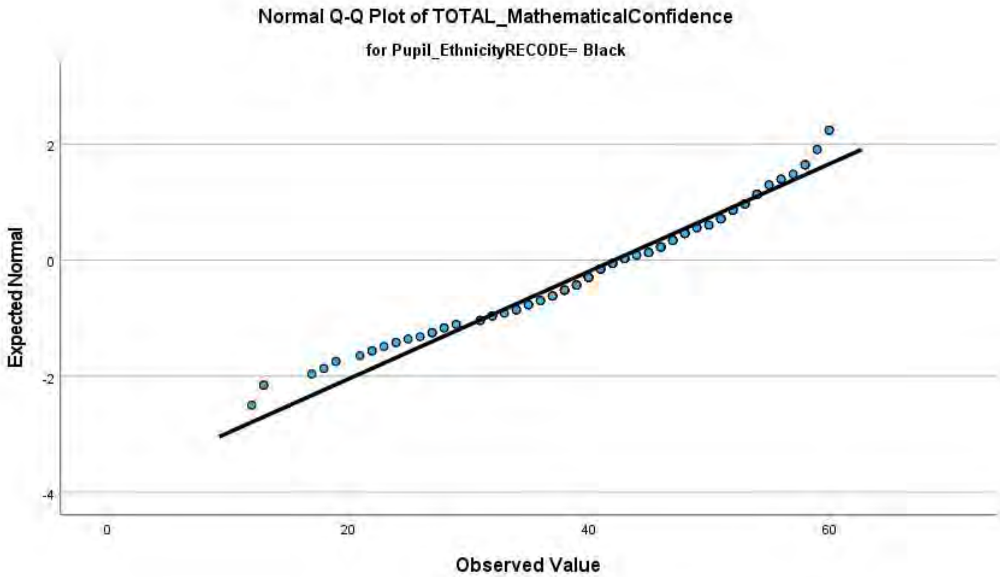
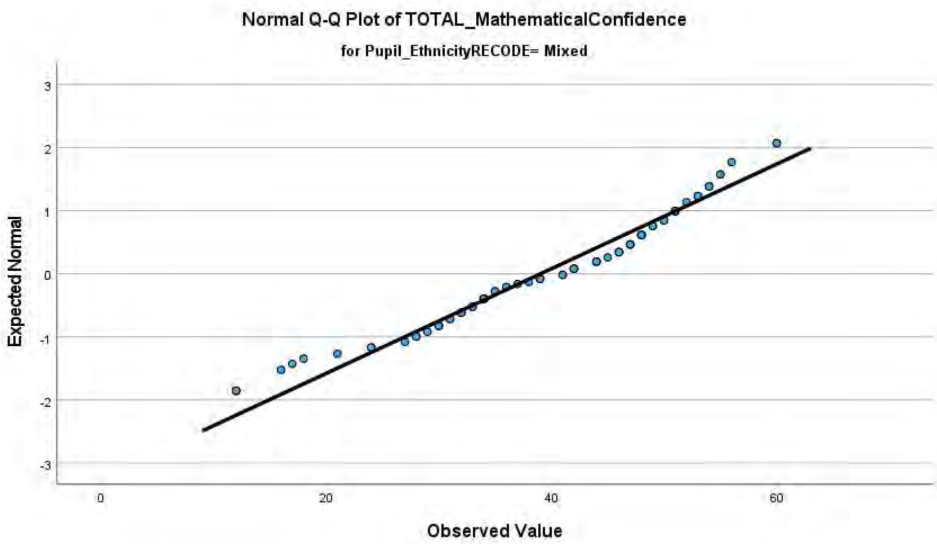
1
0
-1
-2
-3
-4
10
20
30
40
50
60
70


Normal Q-Q Plot of TOTAL_MathematicalConfidence
for Pupil_EthnicityRECODE= Black
Expected Normal
Observed Value
2
0
-2
-4
0
20
40
60


Normal Q-Q Plot of TOTAL_MathematicalConfidence
for Pupil_EthnicityRECODE= Mixed
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
0
20
40
60

Ethnicity output

Descriptives

TOTAL_MathematicalConfidence

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
White	799	39.0088	11.02906	.39018	38.2429	39.7747	12.00	60.00
South Asian	431	43.6868	10.29707	.49599	42.7119	44.6616	12.00	60.00
Chinese	33	49.1212	9.58109	1.66785	45.7239	52.5185	17.00	60.00
Black	159	42.1132	10.78852	.85559	40.4233	43.8031	12.00	60.00
Mixed	77	39.0260	12.06340	1.37475	36.2879	41.7640	12.00	60.00
Total	1499	40.9066	11.08256	.28625	40.3451	41.4681	12.00	60.00

ANOVA

TOTAL_MathematicalConfidence

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8939.846	4	2234.961	19.075	<.001
Within Groups	175049.079	1494	117.168		
Total	183988.925	1498			

Multiple Comparisons

Dependent Variable: TOTAL_MathematicalConfidence

Scheffe

(I) What is your ethnicity?	(J) What is your ethnicity?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
White	South Asian	-4.67801*	.64691	<.001	-6.6731	-2.6829
	Chinese	-10.11245*	1.92281	<.001	-16.0425	-4.1824
	Black	-3.10445*	.93997	.028	-6.0034	-.2055
	Mixed	-.01721	1.29163	1.000	-4.0007	3.9663
South Asian	White	4.67801*	.64691	<.001	2.6829	6.6731
	Chinese	-5.43444	1.95510	.103	-11.4641	.5952
	Black	1.57357	1.00437	.653	-1.5240	4.6711
	Mixed	4.66080*	1.33922	.017	.5305	8.7911
Chinese	White	10.11245*	1.92281	<.001	4.1824	16.0425
	South Asian	5.43444	1.95510	.103	-.5952	11.4641
	Black	7.00800*	2.07062	.022	.6221	13.3939
	Mixed	10.09524*	2.25216	<.001	3.1494	17.0411
Black	White	3.10445*	.93997	.028	.2055	6.0034
	South Asian	-1.57357	1.00437	.653	-4.6711	1.5240
	Chinese	-7.00800*	2.07062	.022	-13.3939	-.6221
	Mixed	3.08723	1.50285	.377	-1.5477	7.7222
Mixed	White	.01721	1.29163	1.000	-3.9663	4.0007
	South Asian	-4.66080*	1.33922	.017	-8.7911	-.5305
	Chinese	-10.09524*	2.25216	<.001	-17.0411	-3.1494
	Black	-3.08723	1.50285	.377	-7.7222	1.5477

*. The mean difference is significant at the 0.05 level.

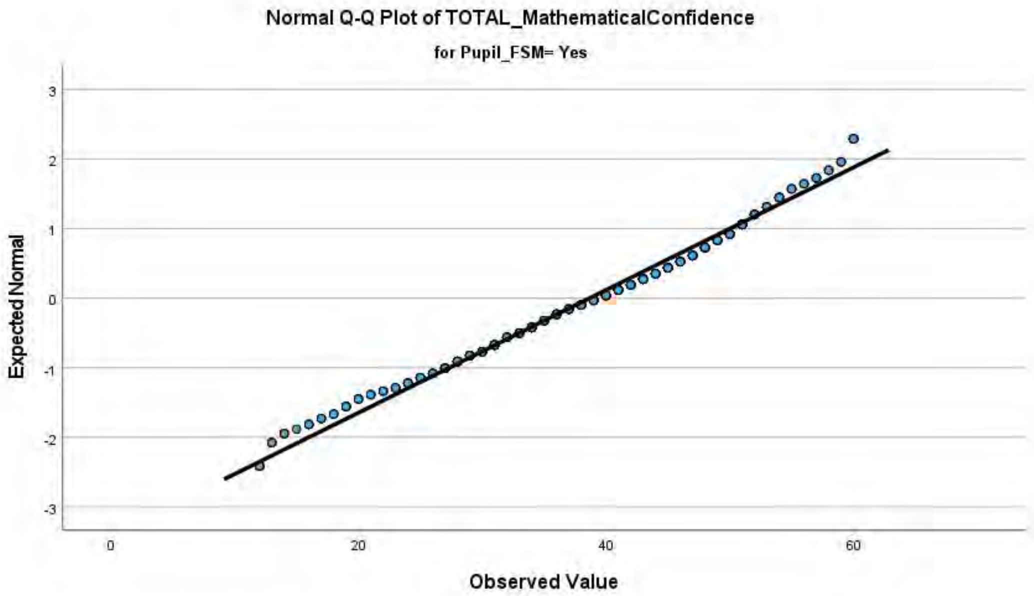
Free school meals parametric assumptions

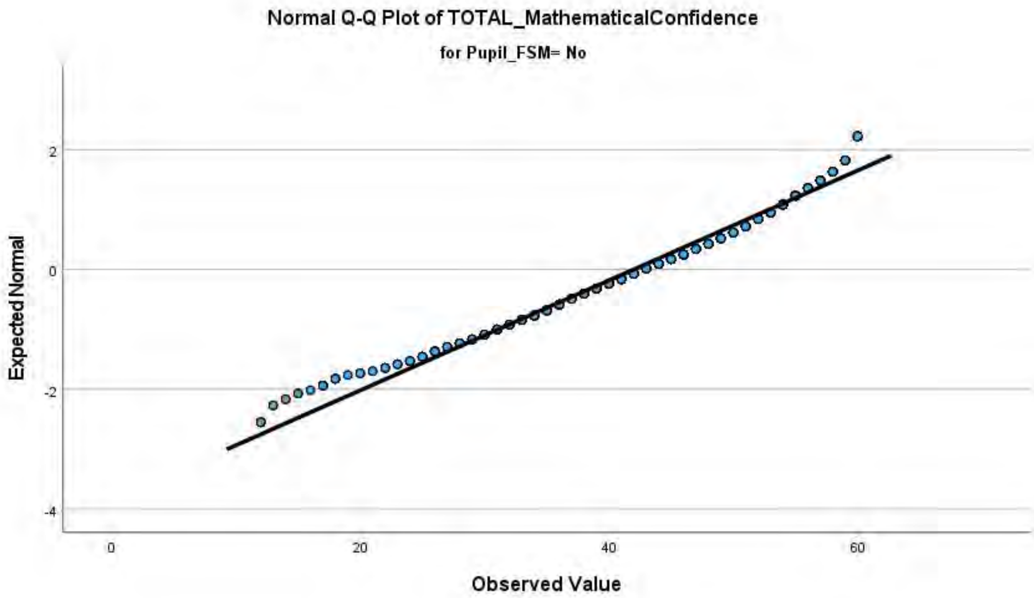
Descriptives

	Do you have free school meals?			Statistic	Std. Error
TOTAL_MathematicalConfidence	Yes	Mean		38.6693	.50792
		95% Confidence Interval for Mean	Lower Bound	37.6714	
			Upper Bound	39.6673	
		5% Trimmed Mean		38.9060	
		Median		39.0000	
		Variance		128.732	
		Std. Deviation		11.34600	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		17.00	
		Skewness		-.295	.109
		Kurtosis		-.534	.218
	No	Mean		41.9820	.32662
		95% Confidence Interval for Mean	Lower Bound	41.3412	
			Upper Bound	42.6229	
		5% Trimmed Mean		42.4369	
		Median		43.0000	
		Variance		118.737	
		Std. Deviation		10.89665	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		16.00	
		Skewness		-.512	.073
		Kurtosis		-.184	.147

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	2.332	1	1610	.127
	Based on Median	2.249	1	1610	.134
	Based on Median and with adjusted df	2.249	1	1609.949	.134
	Based on trimmed mean	2.271	1	1610	.132





Free school meals output

Group Statistics

	Do you have free school meals?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Yes	499	38.6693	11.34600	.50792
	No	1113	41.9820	10.89665	.32662

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	2.332	.127	-5.571	1610	<.001	<.001	-3.31269	.59465	-4.47906	-2.14633
	Equal variances not assumed			-5.486	924.253	<.001	<.001	-3.31269	.60387	-4.49781	-2.12757

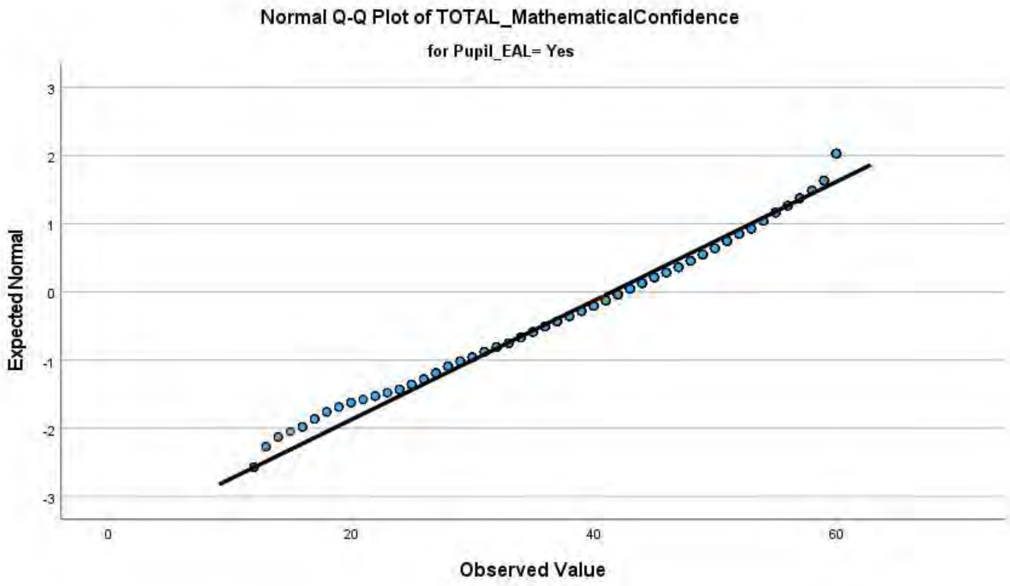
English as an additional language parametric assumption

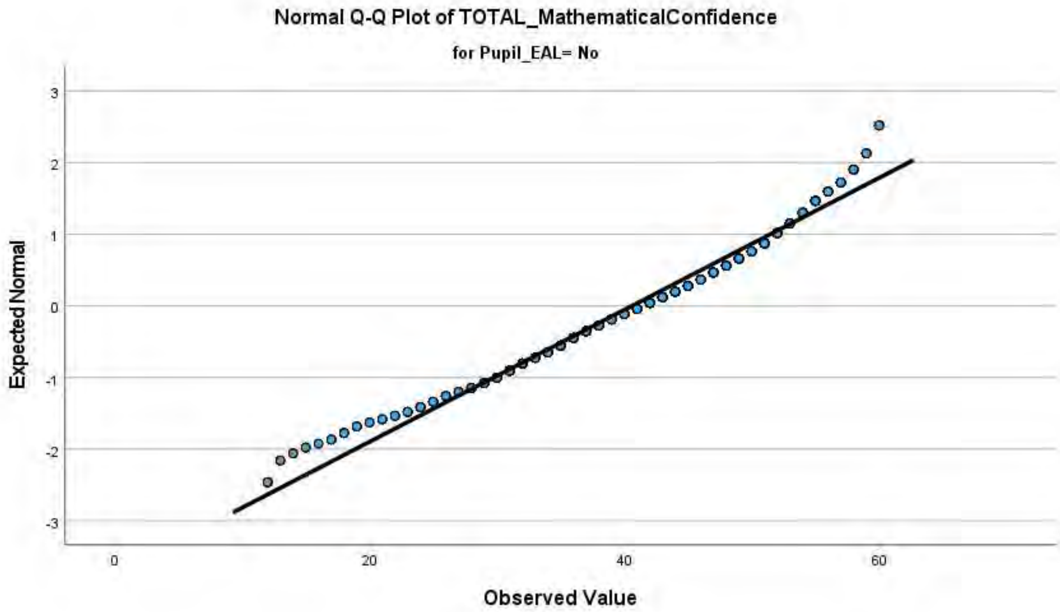
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
TOTAL_MathematicalConfidence	Yes	Mean		41.4861	.43808
		95% Confidence Interval for Mean	Lower Bound	40.6260	
			Upper Bound	42.3463	
		5% Trimmed Mean		41.8982	
		Median		42.0000	
		Variance		131.461	
		Std. Deviation		11.46563	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		16.00	
		Skewness		-.427	.093
		Kurtosis		-.408	.187
	No	Mean		40.5897	.35602
		95% Confidence Interval for Mean	Lower Bound	39.8910	
			Upper Bound	41.2884	
		5% Trimmed Mean		41.0039	
		Median		42.0000	
		Variance		118.004	
		Std. Deviation		10.86294	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.00	
		Skewness		-.483	.080
		Kurtosis		-.249	.160

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	2.300	1	1614	.130
	Based on Median	2.165	1	1614	.141
	Based on Median and with adjusted df	2.165	1	1612.241	.141
	Based on trimmed mean	2.240	1	1614	.135





English as an additional language output

Group Statistics

	Do you speak English as an additional language?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Yes	685	41.4861	11.46563	.43808
	No	931	40.5897	10.86294	.35602

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	2.300	.130	1.601	1614	.055	.110	.89644	.55988	-.20173	1.99462
	Equal variances not assumed			1.588	1427.796	.056	.113	.89644	.56450	-.21090	2.00379

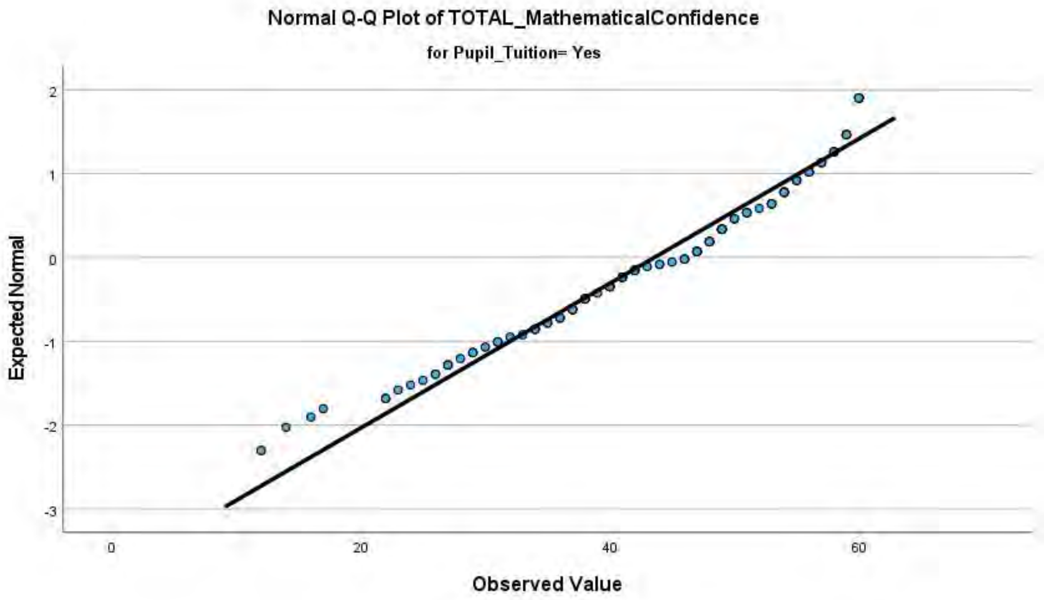
Extra maths tuition parametric assumptions

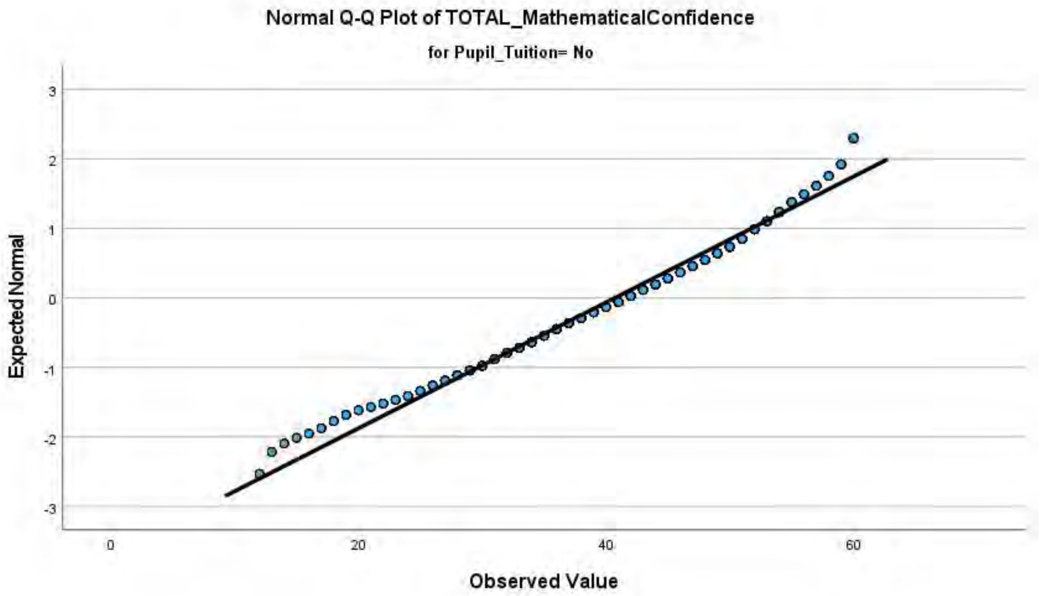
Descriptives

	Do you have extra maths tuition outside of school?			Statistic	Std. Error
TOTAL_MathematicalConfidence	Yes	Mean		43.5755	.98323
		95% Confidence Interval for Mean	Lower Bound	41.6314	
			Upper Bound	45.5197	
		5% Trimmed Mean		44.1735	
		Median		46.0000	
		Variance		134.376	
		Std. Deviation		11.59209	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		16.00	
		Skewness		-.617	.206
		Kurtosis		-.173	.408
	No	Mean		40.7071	.28673
		95% Confidence Interval for Mean	Lower Bound	40.1446	
			Upper Bound	41.2695	
		5% Trimmed Mean		41.0892	
		Median		42.0000	
		Variance		122.090	
		Std. Deviation		11.04943	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.00	
		Skewness		-.439	.064
		Kurtosis		-.324	.127

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	1.014	1	1622	.314
	Based on Median	.701	1	1622	.402
	Based on Median and with adjusted df	.701	1	1618.852	.402
	Based on trimmed mean	.935	1	1622	.334





Extra maths tuition output

Group Statistics

	Do you have extra maths tuition outside of school?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Yes	139	43.5755	11.59209	.98323
	No	1485	40.7071	11.04943	.28673

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	1.014	.314	2.914	1622	.002	.004	2.86847	.98427	.93790	4.79904
	Equal variances not assumed			2.801	162.361	.003	.006	2.86847	1.02418	.84603	4.89091

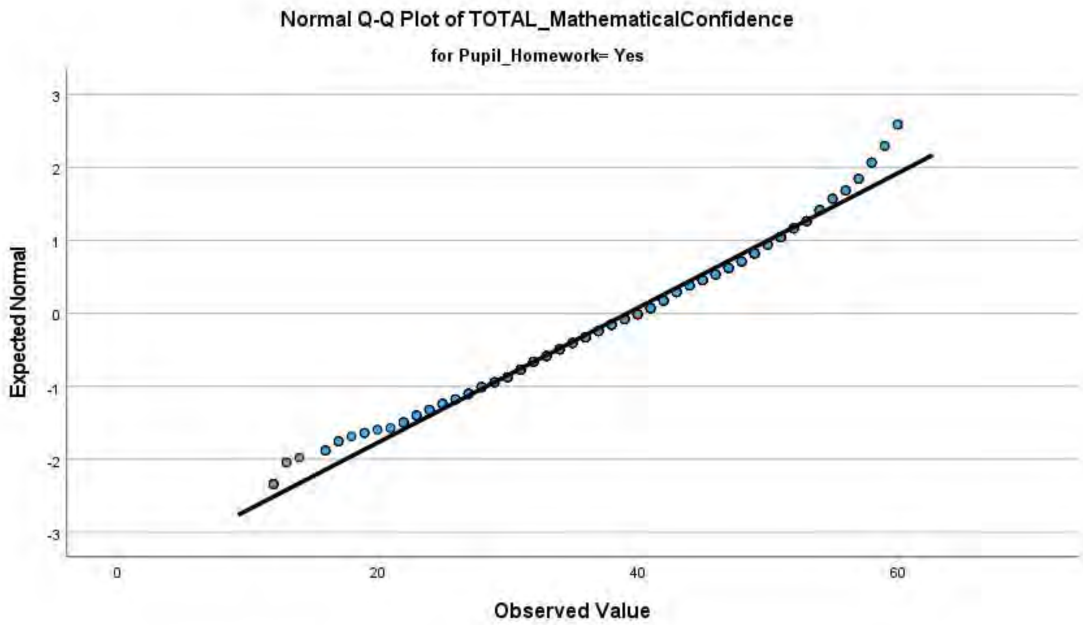
Parents help with homework parametric assumptions

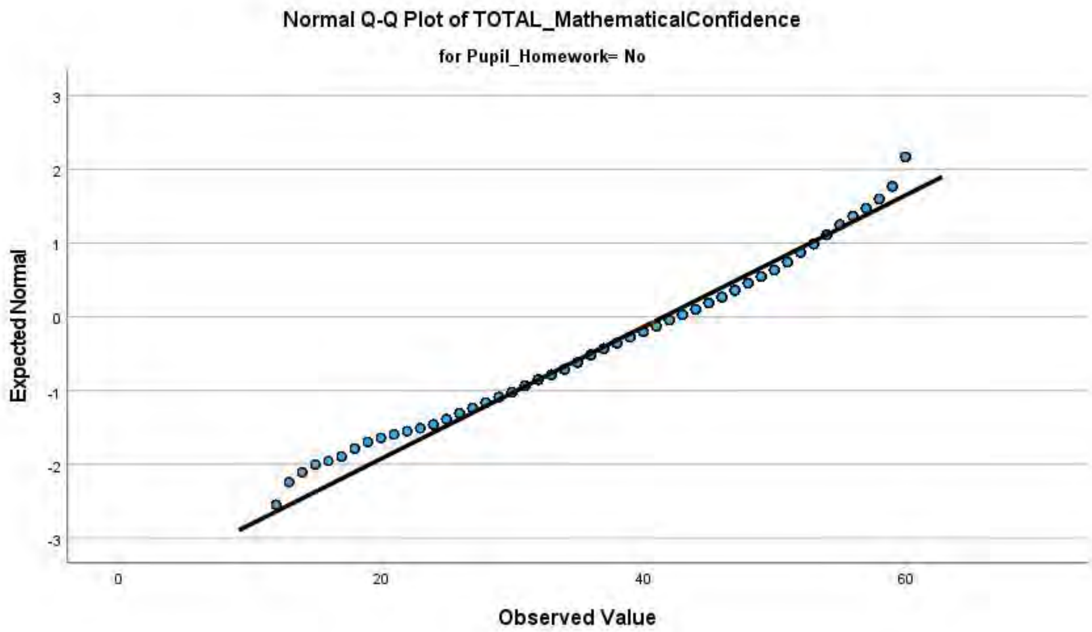
Descriptives

	Do your parents help you with your maths homework?			Statistic	Std. Error
TOTAL_MathematicalConfidence	Yes	Mean		39.1990	.53375
		95% Confidence Interval for Mean	Lower Bound	38.1498	
			Upper Bound	40.2483	
		5% Trimmed Mean		39.5307	
		Median		40.0000	
		Variance		117.376	
		Std. Deviation		10.83404	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.00	
		Skewness		-.373	.120
		Kurtosis		-.336	.240
	No	Mean		41.5477	.32399
		95% Confidence Interval for Mean	Lower Bound	40.9121	
			Upper Bound	42.1834	
		5% Trimmed Mean		41.9862	
		Median		42.0000	
		Variance		125.333	
		Std. Deviation		11.19520	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		17.00	
		Skewness		-.486	.071
		Kurtosis		-.287	.141

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	.828	1	1604	.363
	Based on Median	.803	1	1604	.370
	Based on Median and with adjusted df	.803	1	1603.491	.370
	Based on trimmed mean	.725	1	1604	.394





Parents help with homework output

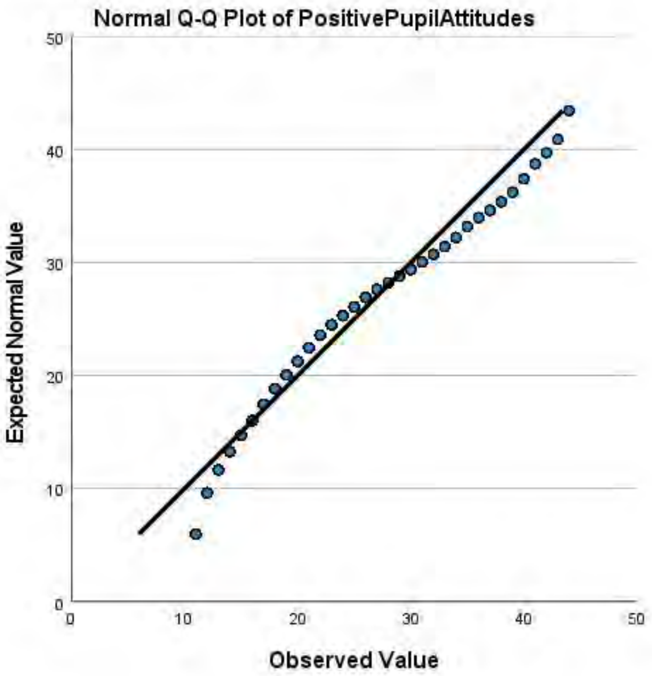
Group Statistics

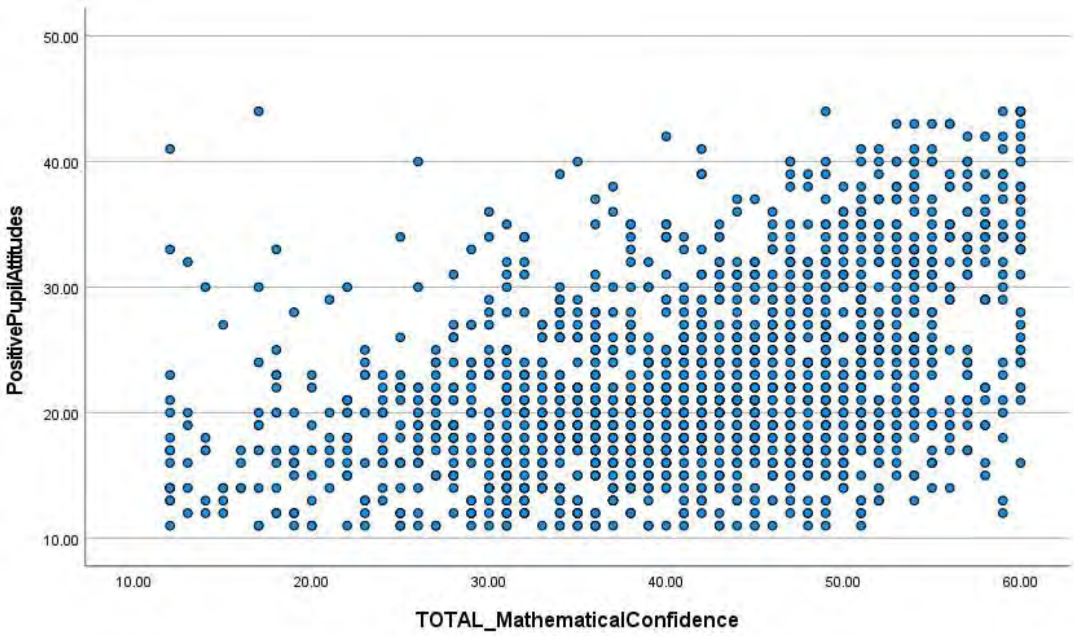
	Do your parents help you with your maths homework?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Yes	412	39.1990	10.83404	.53375
	No	1194	41.5477	11.19520	.32399

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	.828	.363	-3.702	1604	<.001	<.001	-2.34871	.63444	-3.59313	-1.10428
	Equal variances not assumed			-3.762	735.272	<.001	<.001	-2.34871	.62439	-3.57451	-1.12291

Pupils attitudes parametric assumptions





Pupils' attitudes output

Correlations

			PositivePupilAttitudes	TOTAL_MathematicalConfidence
Spearman's rho	PositivePupilAttitudes	Correlation Coefficient	1.000	.433**
		Sig. (2-tailed)	.	<.001
		N	1605	1560
	TOTAL_MathematicalConfidence	Correlation Coefficient	.433**	1.000
		Sig. (2-tailed)	<.001	.
		N	1560	1639

**. Correlation is significant at the 0.01 level (2-tailed).

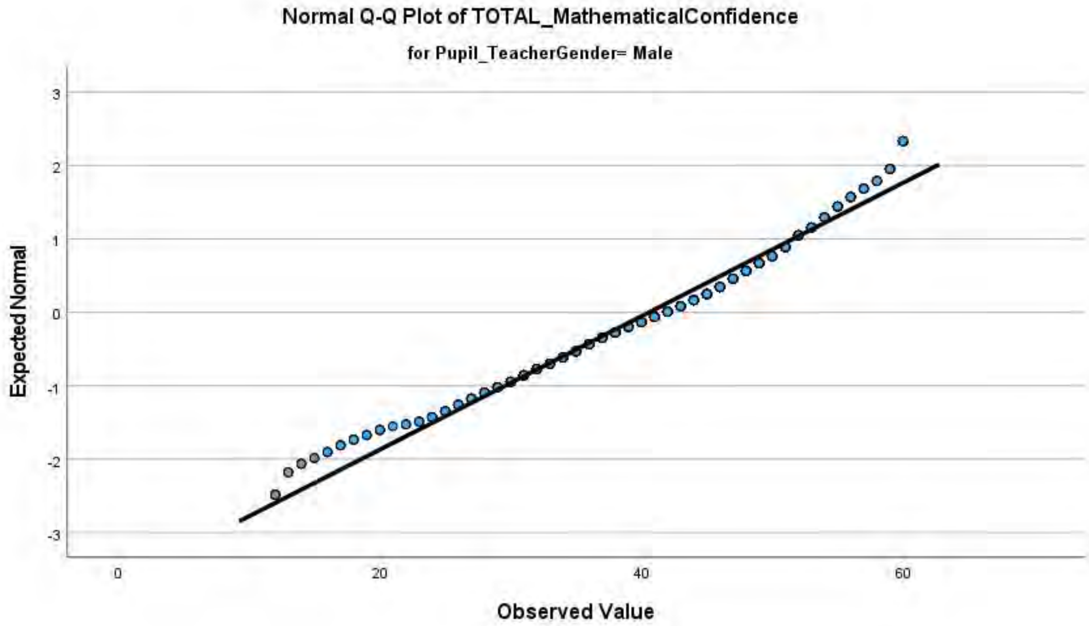
Teacher gender parametric assumptions

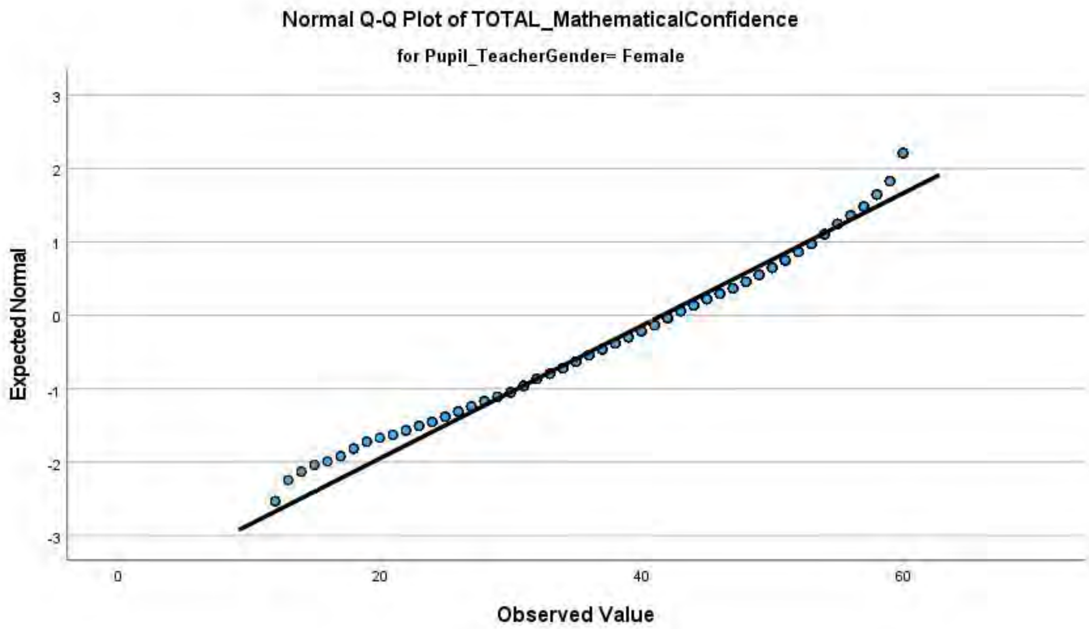
Descriptives

	Is your maths teacher male or female?			Statistic	Std. Error
TOTAL_MathematicalConfidence	Male	Mean		40.5721	.44591
		95% Confidence Interval for Mean	Lower Bound	39.6964	
			Upper Bound	41.4478	
		5% Trimmed Mean		40.9654	
		Median		42.0000	
		Variance		121.290	
		Std. Deviation		11.01315	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		16.00	
		Skewness		-.472	.099
		Kurtosis		-.307	.198
	Female	Mean		41.5829	.35770
		95% Confidence Interval for Mean	Lower Bound	40.8809	
			Upper Bound	42.2849	
		5% Trimmed Mean		42.0206	
		Median		42.0000	
		Variance		122.705	
		Std. Deviation		11.07722	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		16.00	
		Skewness		-.487	.079
		Kurtosis		-.254	.158

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	.042	1	1567	.838
	Based on Median	.019	1	1567	.891
	Based on Median and with adjusted df	.019	1	1566.963	.891
	Based on trimmed mean	.042	1	1567	.838





Teacher gender output

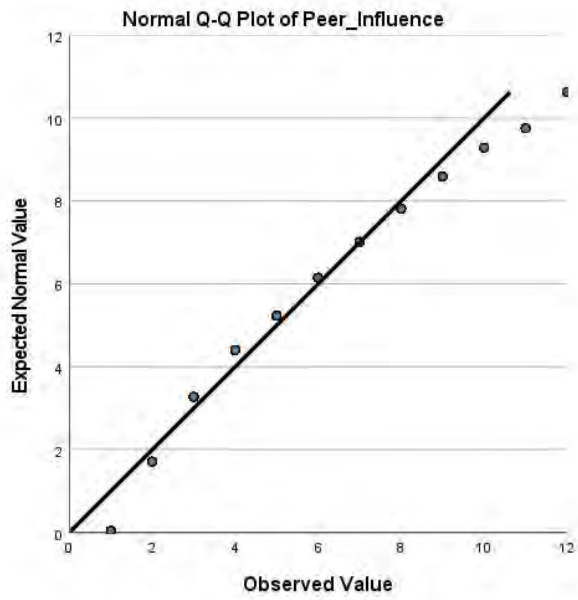
Group Statistics

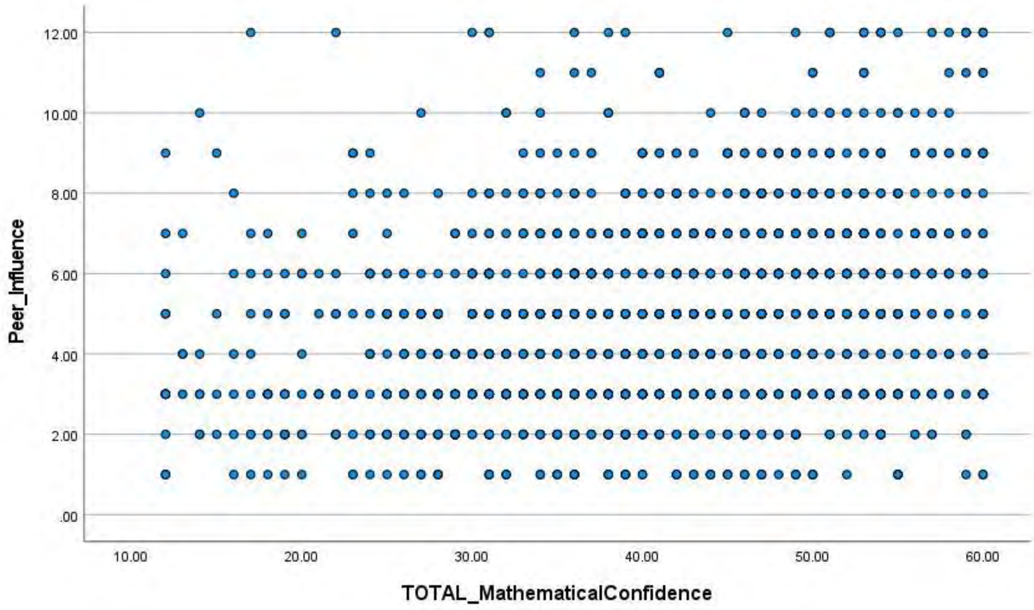
	Is your maths teacher male or female?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Male	610	40.5721	11.01315	.44591
	Female	959	41.5829	11.07722	.35770

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	.042	.838	-1.766	1567	.039	.078	-1.01077	.57239	-2.13350	.11196
	Equal variances not assumed			-1.768	1302.182	.039	.077	-1.01077	.57165	-2.13223	.11069

Peer attitudes parametric assumptions





Peer attitudes output

Correlations

			TOTAL_MathematicalConfidence	Peer_Influence
Spearman's rho	TOTAL_MathematicalConfidence	Correlation Coefficient	1.000	.242**
		Sig. (2-tailed)	.	<.001
		N	1639	1499
	Peer_Influence	Correlation Coefficient	.242**	1.000
		Sig. (2-tailed)	<.001	.
		N	1499	1545

**. Correlation is significant at the 0.01 level (2-tailed).

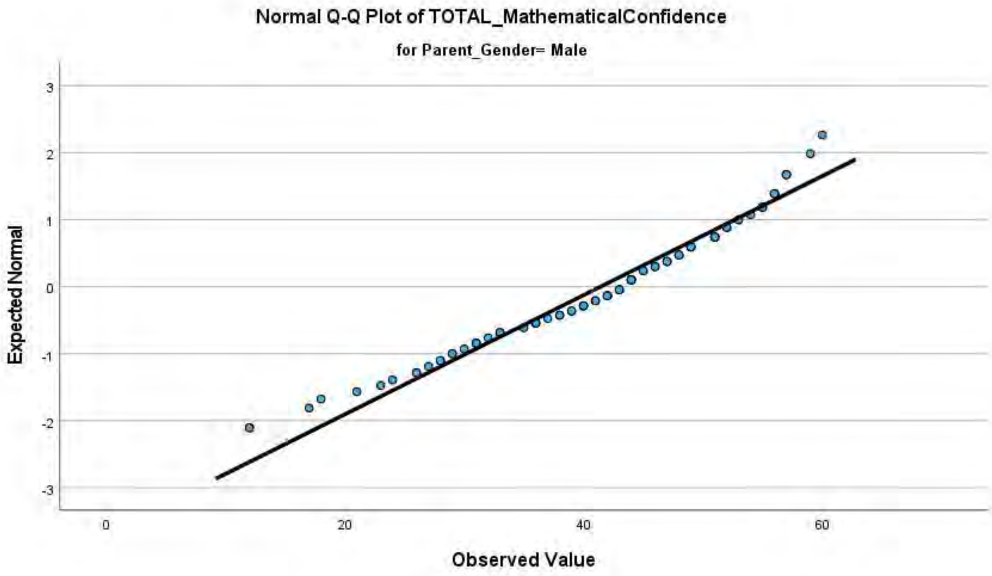
Parent gender parametric assumptions

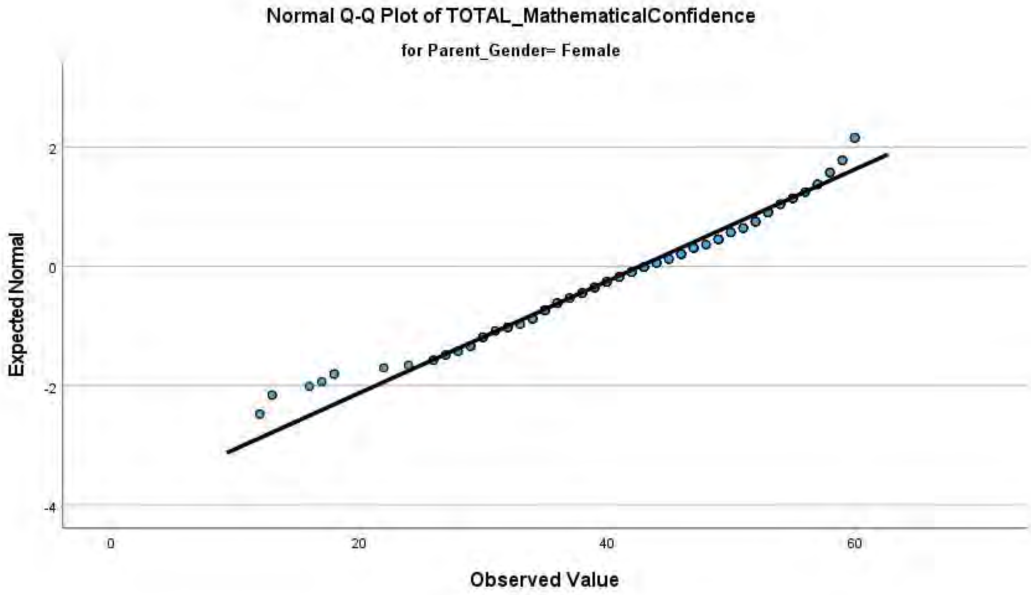
Descriptives

	What is your gender?			Statistic	Std. Error
TOTAL_MathematicalConfidence	Male	Mean		41.4167	1.22804
		95% Confidence Interval for Mean	Lower Bound	38.9741	
			Upper Bound	43.8592	
		5% Trimmed Mean		41.9497	
		Median		43.5000	
		Variance		126.680	
		Std. Deviation		11.25521	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		17.50	
		Skewness		-.606	.263
		Kurtosis		-.151	.520
	Female	Mean		42.6652	.71232
		95% Confidence Interval for Mean	Lower Bound	41.2614	
			Upper Bound	44.0689	
		5% Trimmed Mean		43.1706	
		Median		43.0000	
		Variance		113.659	
		Std. Deviation		10.66108	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.75	
		Skewness		-.537	.163
		Kurtosis		.039	.324

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	.251	1	306	.617
	Based on Median	.099	1	306	.753
	Based on Median and with adjusted df	.099	1	301.009	.753
	Based on trimmed mean	.171	1	306	.680





Parent gender output

Group Statistics

	What is your gender?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Male	84	41.4167	11.25521	1.22804
	Female	224	42.6652	10.66108	.71232

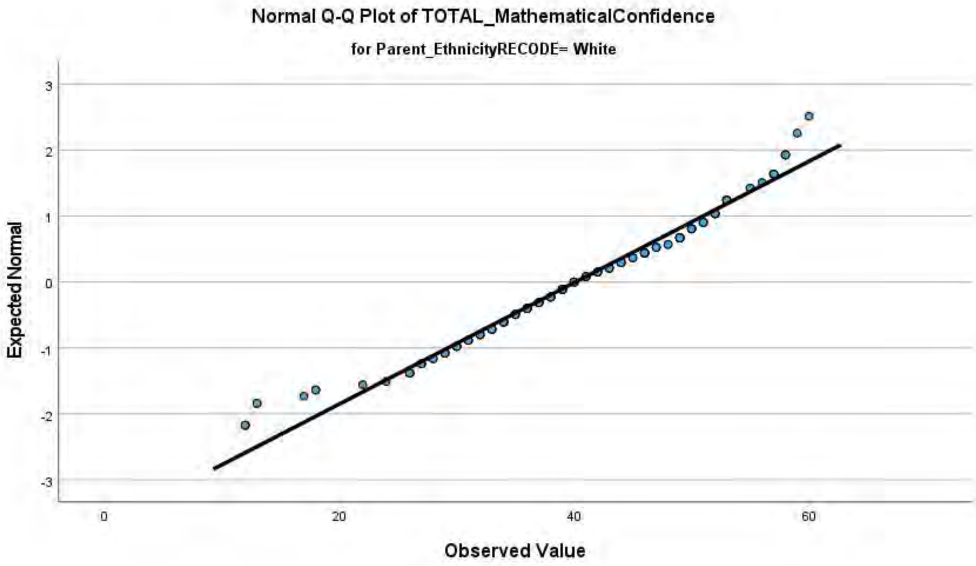
Independent Samples Test

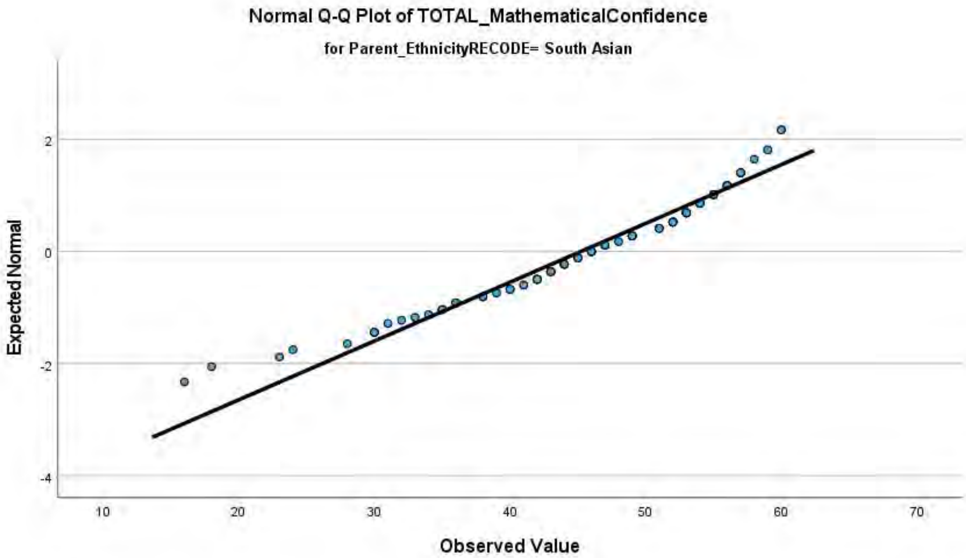
		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	.251	.617	-.901	306	.184	.368	-1.24851	1.38503	-3.97389	1.47687
	Equal variances not assumed			-.879	142.254	.190	.381	-1.24851	1.41968	-4.05491	1.55789

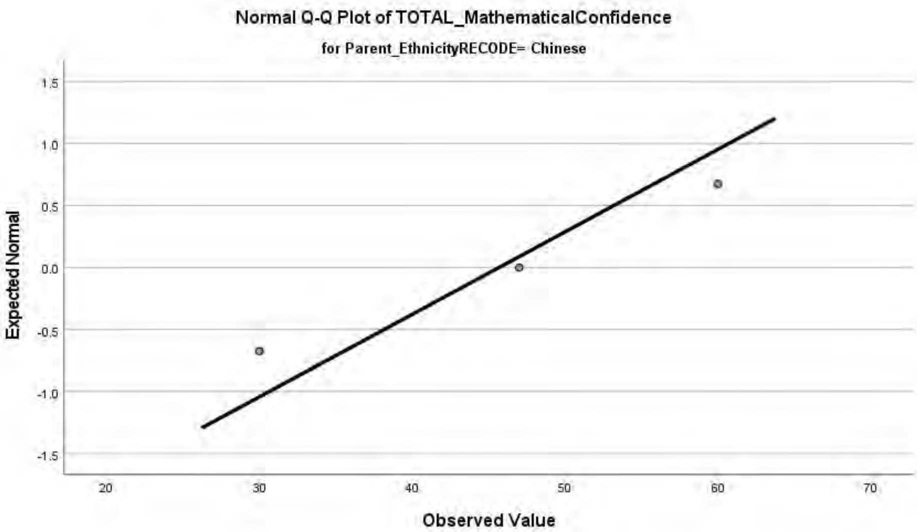
Parent ethnicity parametric assumptions

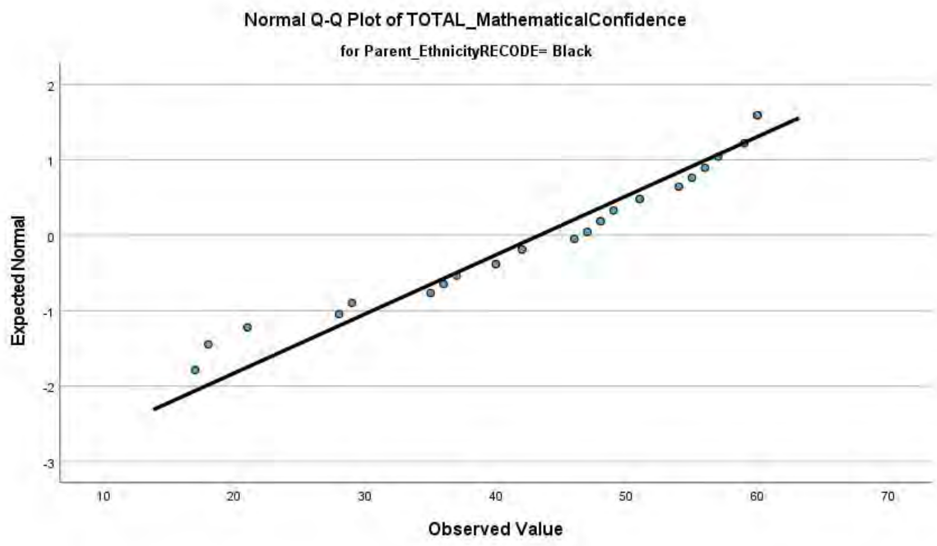
Descriptives

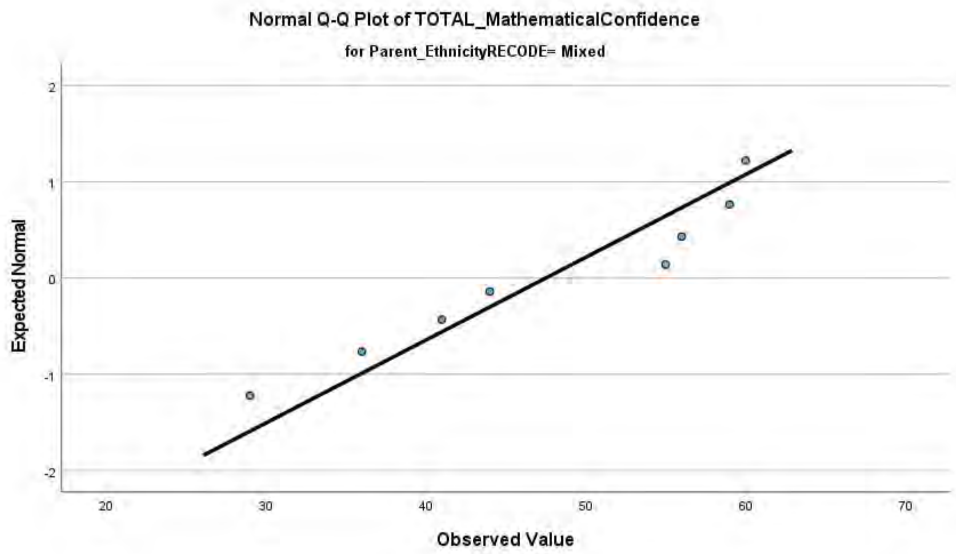
	What is your ethnicity?			Statistic	Std. Error
TOTAL_MathematicalConfidence	White	Mean		40.1145	.84344
		95% Confidence Interval for Mean	Lower Bound	38.4491	
			Upper Bound	41.7798	
		5% Trimmed Mean		40.5790	
		Median		40.0000	
		Variance		118.090	
		Std. Deviation		10.86692	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.25	
		Skewness		-.472	.188
		Kurtosis		-.003	.375
	South Asian	Mean		45.2222	.95827
		95% Confidence Interval for Mean	Lower Bound	43.3206	
			Upper Bound	47.1239	
		5% Trimmed Mean		45.7497	
		Median		46.0000	
		Variance		90.909	
		Std. Deviation		9.53464	
		Minimum		16.00	
		Maximum		60.00	
		Range		44.00	
		Interquartile Range		13.00	
		Skewness		-.763	.243
		Kurtosis		.363	.481
	Chinese	Mean		45.6667	8.68588
		95% Confidence Interval for Mean	Lower Bound	8.2944	
			Upper Bound	83.0390	
		5% Trimmed Mean		.	
		Median		47.0000	
		Variance		226.333	
		Std. Deviation		15.04438	
		Minimum		30.00	
		Maximum		60.00	
		Range		30.00	
		Interquartile Range		.	
		Skewness		-.396	1.225
		Kurtosis		.	.
	Black	Mean		43.3077	2.50401
		95% Confidence Interval for Mean	Lower Bound	38.1506	
			Upper Bound	48.4648	
		5% Trimmed Mean		43.8291	
		Median		46.5000	
		Variance		163.022	
		Std. Deviation		12.76799	
		Minimum		17.00	
		Maximum		60.00	
		Range		43.00	
		Interquartile Range		18.50	
		Skewness		-.653	.456
		Kurtosis		-.409	.887
	Mixed	Mean		47.5000	4.11009
		95% Confidence Interval for Mean	Lower Bound	37.7812	
			Upper Bound	57.2188	
		5% Trimmed Mean		47.8333	
		Median		49.5000	
		Variance		135.143	
		Std. Deviation		11.62510	
		Minimum		29.00	
		Maximum		60.00	
		Range		31.00	
		Interquartile Range		21.00	
		Skewness		-.444	.752
		Kurtosis		-1.392	1.481


Normal Q-Q Plot of TOTAL_MathematicalConfidence
for Parent_EthnicityRECODE= White
Expected Normal
Observed Value


Normal Q-Q Plot of TOTAL_MathematicalConfidence
for Parent_EthnicityRECODE= South Asian
Expected Normal
Observed Value


Normal Q-Q Plot of TOTAL_MathematicalConfidence
for Parent_EthnicityRECODE= Chinese
Expected Normal
Observed Value





Parent ethnicity output

Descriptives

TOTAL_MathematicalConfidence

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
White	166	40.1145	10.86692	.84344	38.4491	41.7798	12.00	60.00
South Asian	99	45.2222	9.53464	.95827	43.3206	47.1239	16.00	60.00
Black	26	43.3077	12.76799	2.50401	38.1506	48.4648	17.00	60.00
Total	291	42.1375	10.84793	.63592	40.8859	43.3891	12.00	60.00

ANOVA

TOTAL_MathematicalConfidence

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1657.027	2	828.513	7.349	<.001
Within Groups	32469.475	288	112.741		
Total	34126.502	290			

Multiple Comparisons

Dependent Variable: TOTAL_MathematicalConfidence

Scheffe

(I) What is your ethnicity?	(J) What is your ethnicity?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
White	South Asian	-5.10776*	1.34832	<.001	-8.4253	-1.7902
	Black	-3.19323	2.23950	.363	-8.7036	2.3171
South Asian	White	5.10776*	1.34832	<.001	1.7902	8.4253
	Black	1.91453	2.33987	.716	-3.8428	7.6719
Black	White	3.19323	2.23950	.363	-2.3171	8.7036
	South Asian	-1.91453	2.33987	.716	-7.6719	3.8428

*. The mean difference is significant at the 0.05 level.

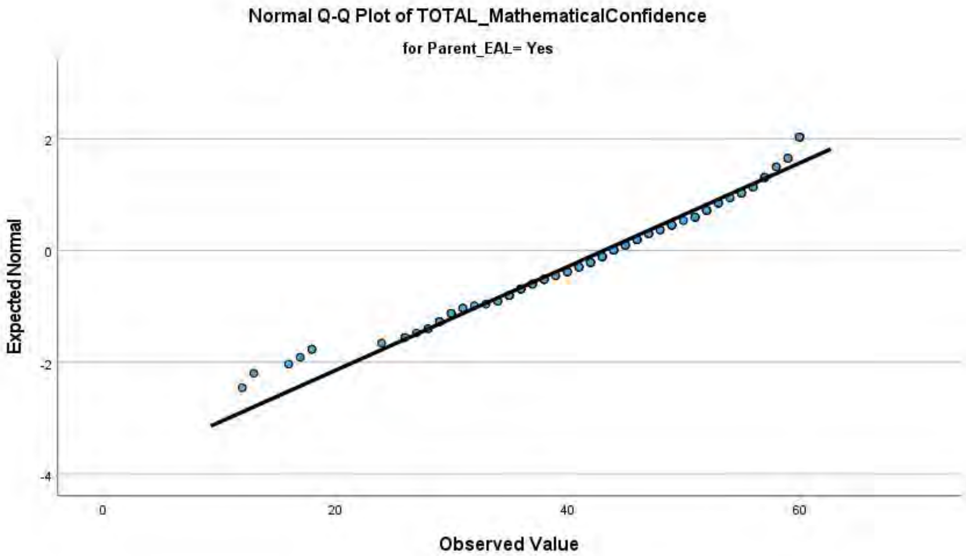
Parent English as an Additional Language parametric assumptions

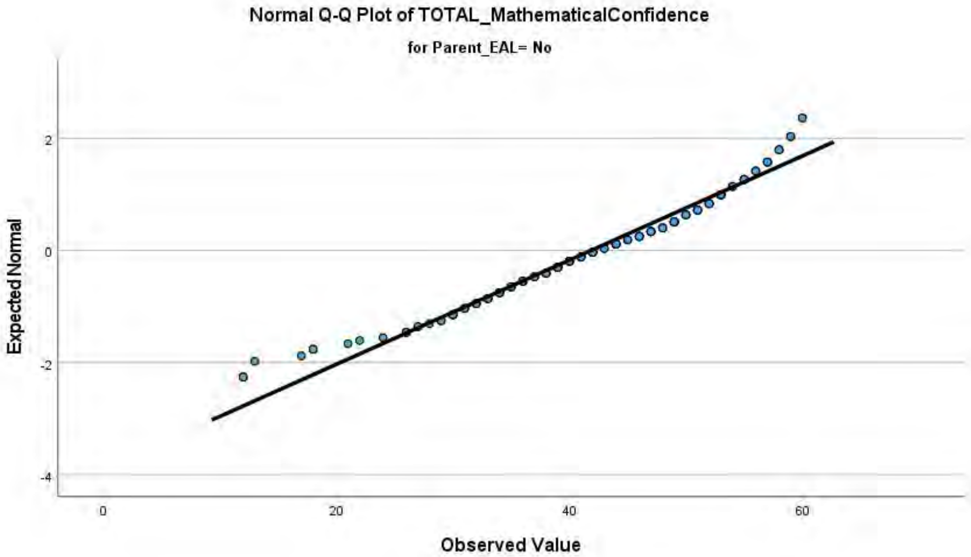
Descriptives

	Do you speak English as an additional language?			Statistic	Std. Error
TOTAL_MathematicalConfidence	Yes	Mean		43.1206	.90739
		95% Confidence Interval for Mean	Lower Bound	41.3266	
			Upper Bound	44.9145	
		5% Trimmed Mean		43.6545	
		Median		44.0000	
		Variance		116.093	
		Std. Deviation		10.77462	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		16.00	
		Skewness		-.588	.204
		Kurtosis		.075	.406
	No	Mean		41.8485	.83788
		95% Confidence Interval for Mean	Lower Bound	40.1941	
			Upper Bound	43.5029	
		5% Trimmed Mean		42.3788	
		Median		42.0000	
		Variance		115.837	
		Std. Deviation		10.76274	
		Minimum		12.00	
		Maximum		60.00	
		Range		48.00	
		Interquartile Range		15.50	
		Skewness		-.578	.189
		Kurtosis		.050	.376

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
TOTAL_MathematicalConfidence	Based on Mean	.041	1	304	.840
	Based on Median	.052	1	304	.819
	Based on Median and with adjusted df	.052	1	303.337	.819
	Based on trimmed mean	.049	1	304	.825





Parents English as an Additional Language output

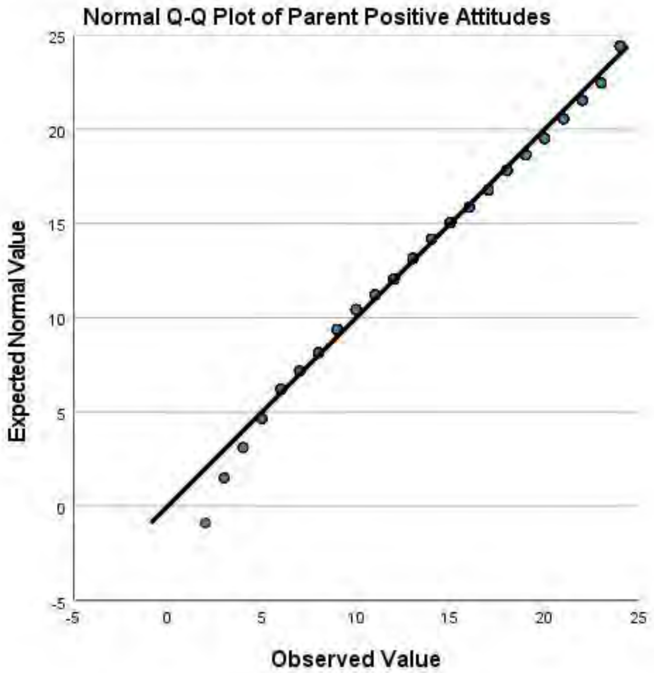
Group Statistics

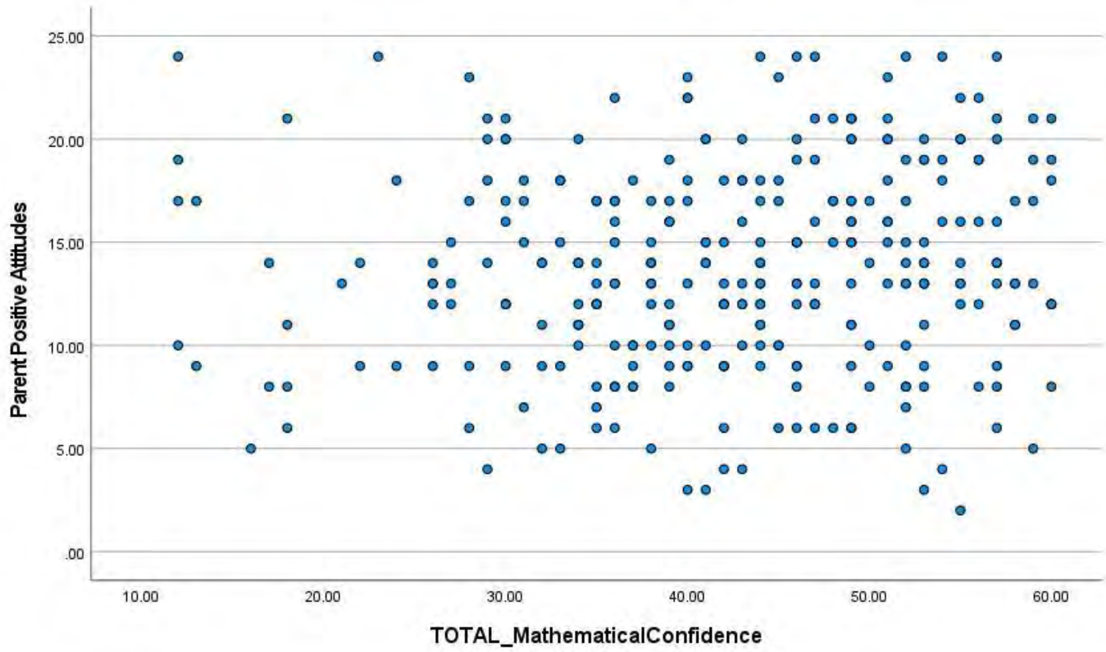
	Do you speak English as an additional language?	N	Mean	Std. Deviation	Std. Error Mean
TOTAL_MathematicalConfidence	Yes	141	43.1206	10.77462	.90739
	No	165	41.8485	10.76274	.83788

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p			Lower	Upper
TOTAL_MathematicalConfidence	Equal variances assumed	.041	.840	1.030	304	.152	.304	1.27208	1.23496	-1.15807	3.70223
	Equal variances not assumed			1.030	296.507	.152	.304	1.27208	1.23507	-1.15853	3.70269

Parent attitudes parametric assumptions





Parent attitudes output

Correlations

			TOTAL_MathematicalConfidence	Parent Positive Attitudes
Spearman's rho	TOTAL_MathematicalConfidence	Correlation Coefficient	1.000	.115*
		Sig. (2-tailed)	.	.046
		N	1639	302
	Parent Positive Attitudes	Correlation Coefficient	.115*	1.000
		Sig. (2-tailed)	.046	.
		N	302	368

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix D: Regression

Appendix D.1: In school value

Parametric assumptions

Correlations

		In school value	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
Pearson Correlation	In school value	1.000	.038	-.054	.025	.121	-.054	-.007	.112	.105
	Gender	.038	1.000	-.118	.009	-.041	-.048	.106	.044	.137
	EAL	-.054	-.118	1.000	.076	.499	.086	-.114	.117	.001
	FSM	.025	.009	.076	1.000	-.065	.131	.094	-.010	-.045
	ETH3=SOUTH ASIAN	.121	-.041	.499	-.065	1.000	-.281	.041	.149	.163
	ETH3=BLACK	-.054	-.048	.086	.131	-.281	1.000	-.087	.065	-.031
	TeacherGender_RECODE=Female	-.007	.106	-.114	.094	.041	-.087	1.000	.034	-.043
	Parent Positive Attitudes	.112	.044	.117	-.010	.149	.065	.034	1.000	.097
	Peer_Influence	.105	.137	.001	-.045	.163	-.031	-.043	.097	1.000
Sig. (1-tailed)	In school value	.	.308	.237	.371	.052	.234	.460	.067	.080
	Gender	.308	.	.057	.454	.291	.262	.078	.281	.033
	EAL	.237	.057	.	.154	.000	.125	.064	.060	.494
	FSM	.371	.454	.154	.	.193	.040	.104	.447	.276
	ETH3=SOUTH ASIAN	.052	.291	.000	.193	.	.000	.293	.023	.014
	ETH3=BLACK	.234	.262	.125	.040	.000	.	.122	.192	.338
	TeacherGender_RECODE=Female	.460	.078	.064	.104	.293	.122	.	.326	.283
	Parent Positive Attitudes	.067	.281	.060	.447	.023	.192	.326	.	.097
	Peer_Influence	.080	.033	.494	.276	.014	.338	.283	.097	.
N	In school value	180	180	180	180	180	180	180	180	180
	Gender	180	180	180	180	180	180	180	180	180
	EAL	180	180	180	180	180	180	180	180	180
	FSM	180	180	180	180	180	180	180	180	180
	ETH3=SOUTH ASIAN	180	180	180	180	180	180	180	180	180
	ETH3=BLACK	180	180	180	180	180	180	180	180	180
	TeacherGender_RECODE=Female	180	180	180	180	180	180	180	180	180
	Parent Positive Attitudes	180	180	180	180	180	180	180	180	180
	Peer_Influence	180	180	180	180	180	180	180	180	180

Coefficients[a]

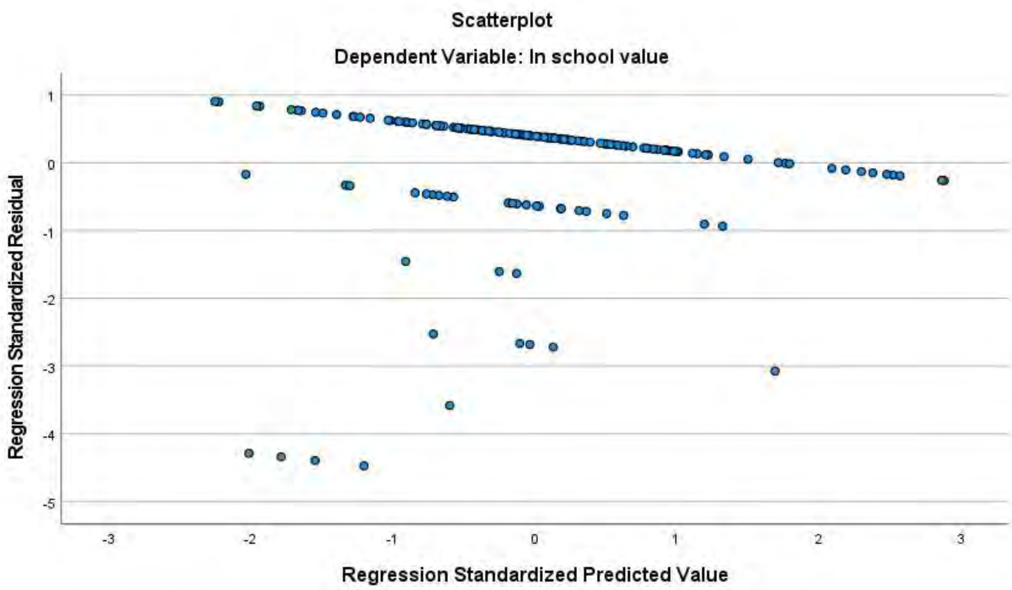
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	5.163	.321		16.104	<.001					
	Gender	.032	.151	.016	.215	.830	.038	.016	.016	.953	1.049
	EAL	-.324	.181	-.164	-1.785	.076	-.054	-.135	-.133	.660	1.515
	FSM	.130	.172	.057	.753	.452	.025	.057	.056	.957	1.045
	ETH3=SOUTH ASIAN	.373	.196	.183	1.906	.058	.121	.144	.142	.602	1.661
	ETH3=BLACK	-.011	.238	-.004	-.046	.963	-.054	-.004	-.003	.832	1.201
	TeacherGender_RECODE =Female	-.087	.159	-.042	-.544	.587	-.007	-.042	-.041	.943	1.060
	Parent Positive Attitudes	.022	.017	.099	1.300	.195	.112	.099	.097	.955	1.047
	Peer_Influence	.027	.032	.064	.832	.406	.105	.064	.062	.933	1.071

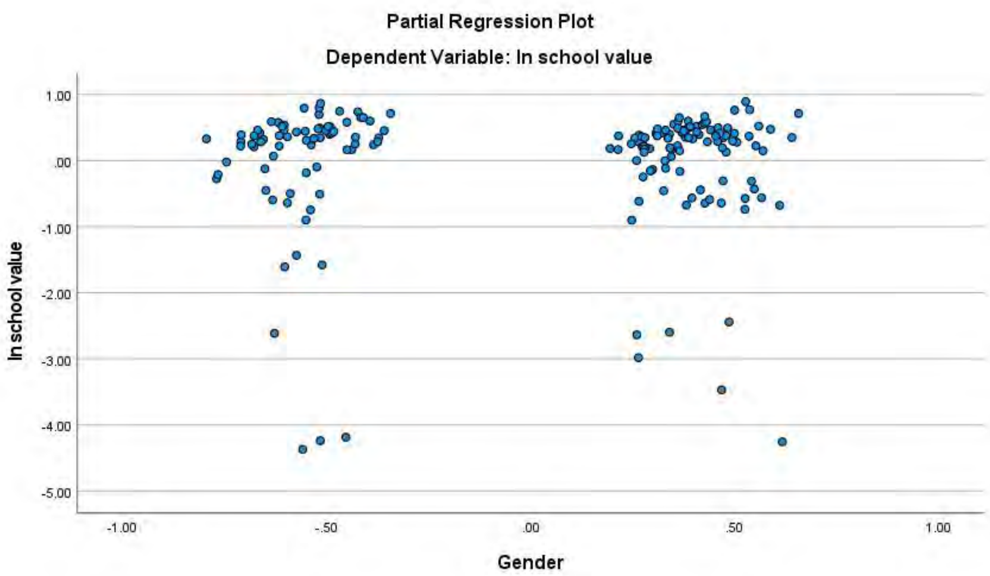
a. Dependent Variable: In school value

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
1	1	5.525	1.000	.00	.01	.01	.01	.01	.00	.01	.00	.00
	2	1.065	2.278	.00	.00	.01	.08	.11	.38	.00	.00	.00
	3	.773	2.673	.00	.08	.20	.00	.07	.16	.04	.00	.00
	4	.681	2.849	.00	.01	.00	.86	.00	.14	.00	.00	.00
	5	.335	4.060	.00	.66	.05	.01	.00	.00	.34	.00	.00
	6	.247	4.731	.02	.18	.10	.00	.43	.24	.20	.03	.07
	7	.239	4.806	.00	.04	.56	.04	.35	.06	.30	.01	.07
	8	.099	7.485	.01	.00	.04	.00	.01	.00	.06	.39	.64
	9	.036	12.334	.96	.01	.02	.01	.02	.00	.06	.57	.22

a. Dependent Variable: In school value




Partial Regression Plot
Dependent Variable: In school value
In school value
1.00
.00
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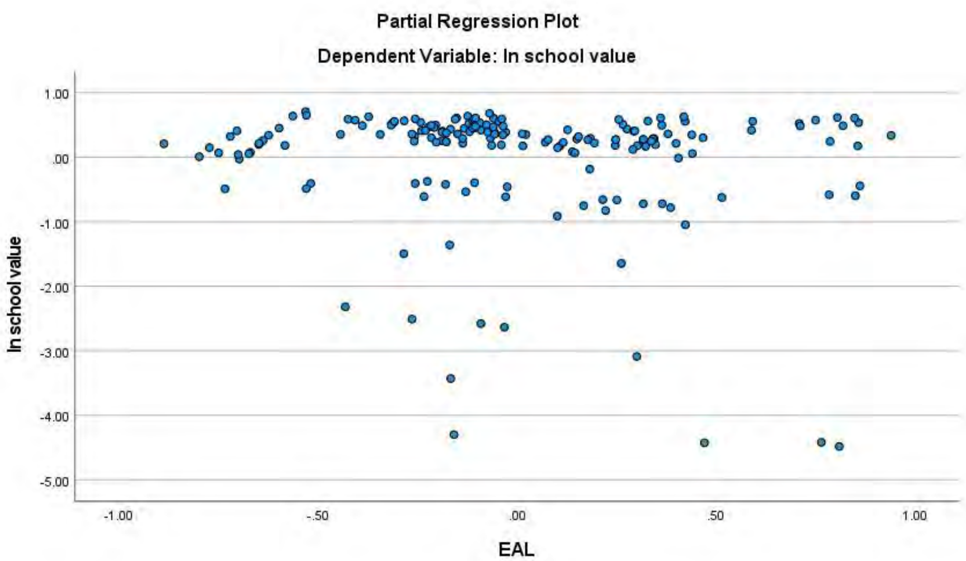
-2.00
-3.00
-4.00
-5.00
-1.00
-.50
.00
.50
1.00
Gender


Partial Regression Plot
Dependent Variable: In school value
In school value
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-1.00
-2.00
-3.00
-4.00
-5.00
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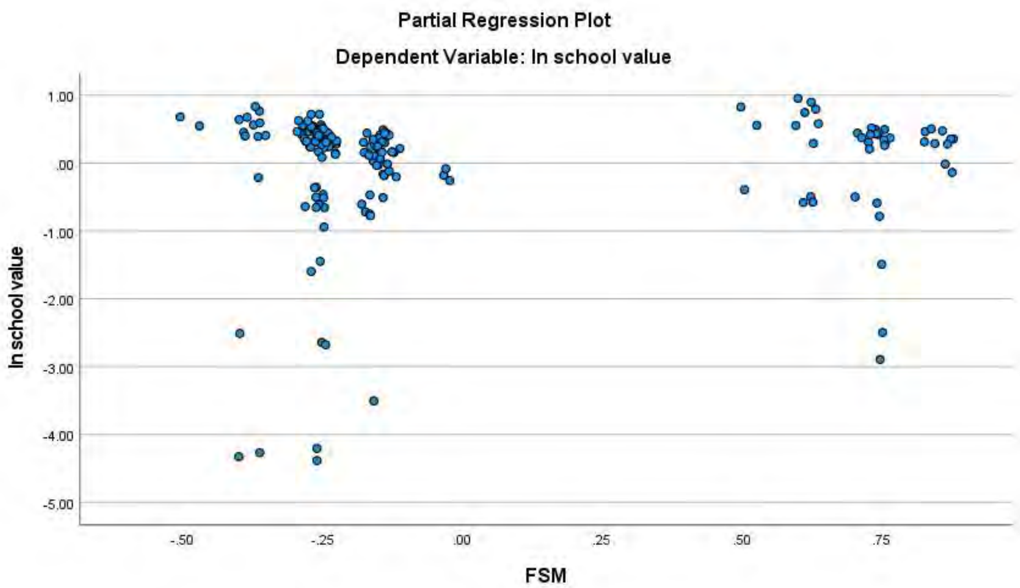
.00
.50
1.00
EAL


Partial Regression Plot
Dependent Variable: In school value
In school value
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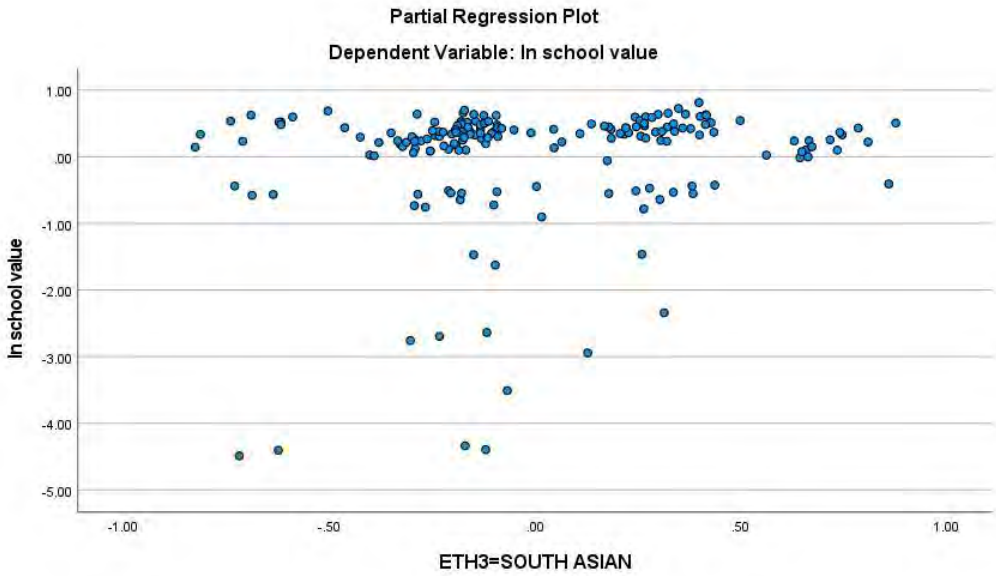
.00
-1.00
-2.00
-3.00
-4.00
-5.00
-.50
-.25
.00
.25
.50
.75
FSM


Partial Regression Plot
Dependent Variable: ln school value
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.00
-1.00
-2.00
-3.00
-4.00
-5.00
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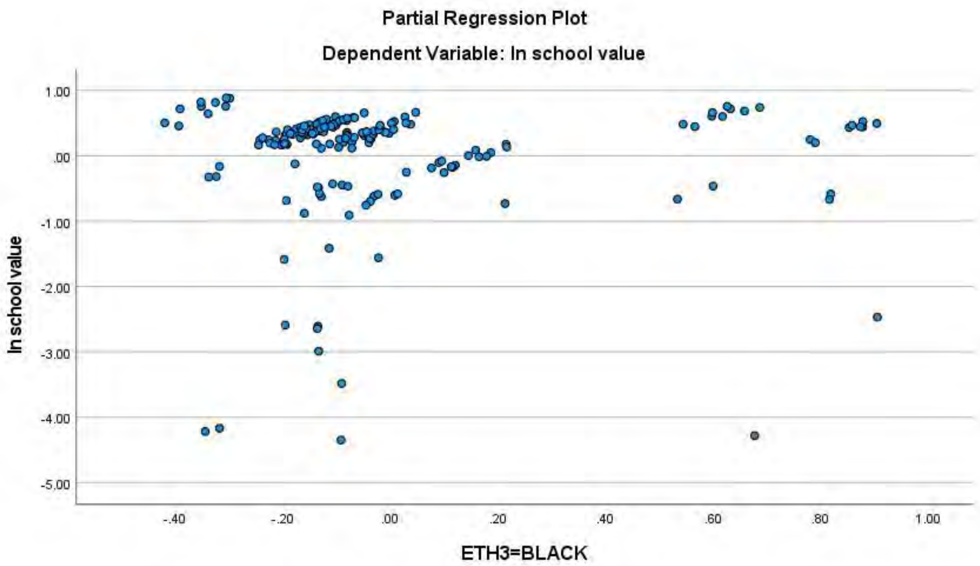
1.00
ETH3=SOUTH ASIAN


Partial Regression Plot
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-2.00
-3.00
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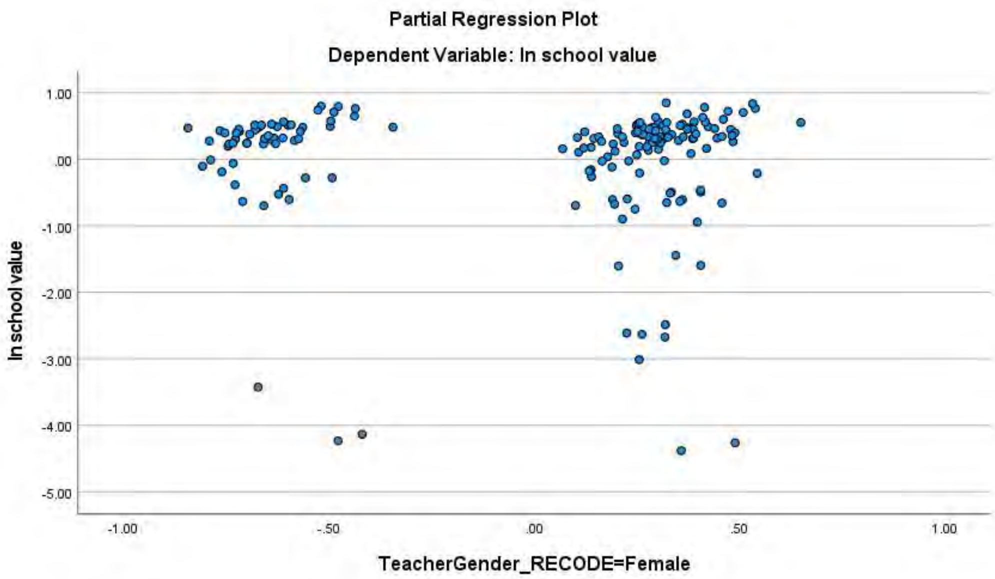
-5.00
-.40
-.20
.00
.20
.40
.60
.80
1.00
ETH3=BLACK


Partial Regression Plot
Dependent Variable: ln school value
ln school value
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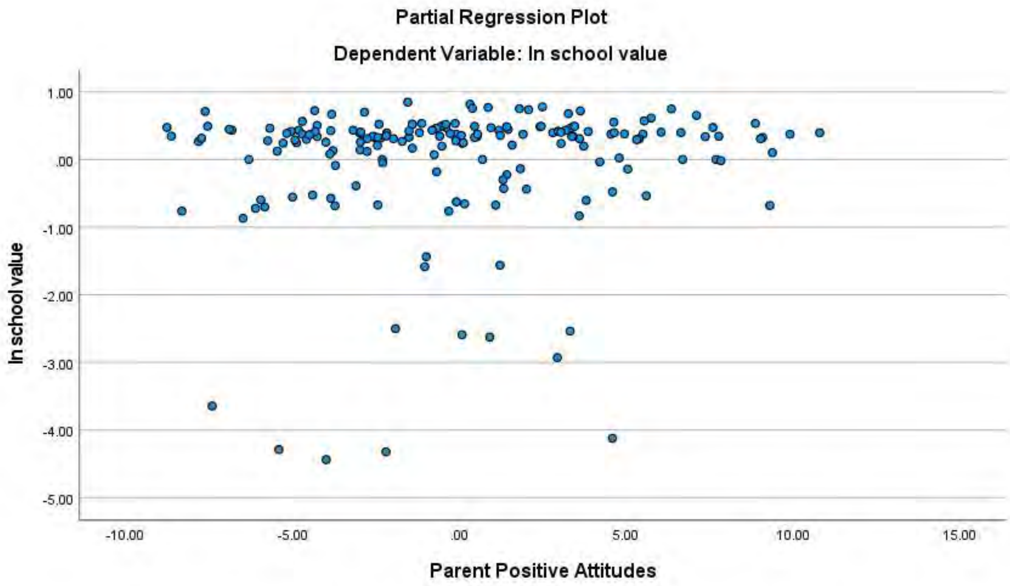
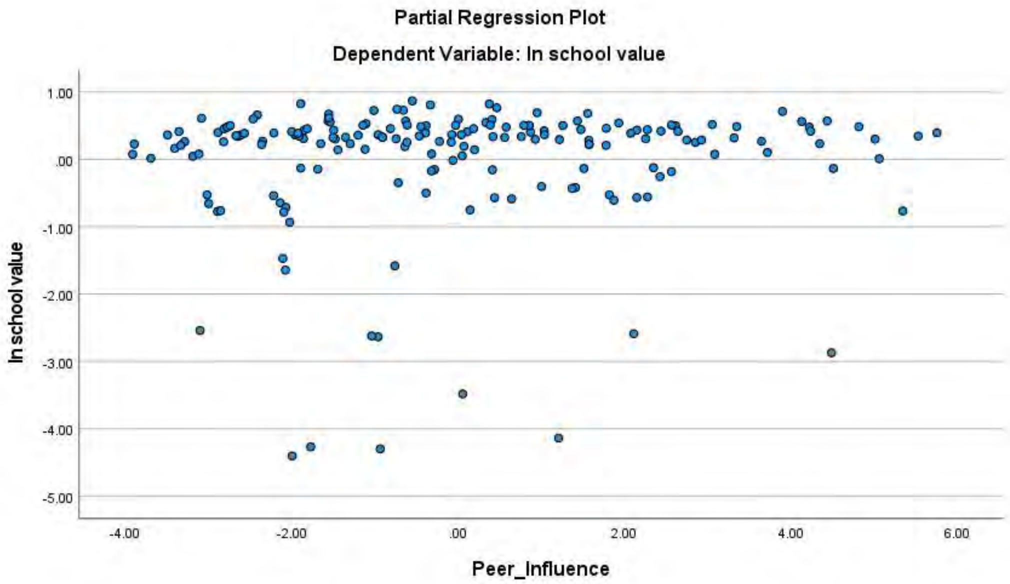
.00
-1.00
-2.00
-3.00
-4.00
-5.00
-1.00
-.50
.00
.50
1.00
TeacherGender_RECODE=Female





Output

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.227[a]	.051	.007	.97266

a. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

b. Dependent Variable: In school value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.771	8	1.096	1.159	.327[b]
	Residual	161.779	171	.946		
	Total	170.550	179			

a. Dependent Variable: In school value

b. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	5.163	.321		16.104	<.001					
	Gender	.032	.151	.016	.215	.830	.038	.016	.016	.953	1.049
	EAL	-.324	.181	-.164	-1.785	.076	-.054	-.135	-.133	.660	1.515
	FSM	.130	.172	.057	.753	.452	.025	.057	.056	.957	1.045
	ETH3=SOUTH ASIAN	.373	.196	.183	1.906	.058	.121	.144	.142	.602	1.661
	ETH3=BLACK	-.011	.238	-.004	-.046	.963	-.054	-.004	-.003	.832	1.201
	TeacherGender_RECODE =Female	-.087	.159	-.042	-.544	.587	-.007	-.042	-.041	.943	1.060
	Parent Positive Attitudes	.022	.017	.099	1.300	.195	.112	.099	.097	.955	1.047
	Peer_Influence	.027	.032	.064	.832	.406	.105	.064	.062	.933	1.071

a. Dependent Variable: In school value

Appendix D.2: Out-School value

Parametric assumptions

Correlations

		Out school value	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
Pearson Correlation	Out school value	1.000	.172	-.069	-.064	-.028	.115	-.023	.095	.236
	Gender	.172	1.000	-.118	.009	-.041	-.048	.106	.044	.137
	EAL	-.069	-.118	1.000	.076	.499	.086	-.114	.117	.001
	FSM	-.064	.009	.076	1.000	-.065	.131	.094	-.010	-.045
	ETH3=SOUTH ASIAN	-.028	-.041	.499	-.065	1.000	-.281	.041	.149	.163
	ETH3=BLACK	.115	-.048	.086	.131	-.281	1.000	-.087	.065	-.031
	TeacherGender_RECODE =Female	-.023	.106	-.114	.094	.041	-.087	1.000	.034	-.043
	Parent Positive Attitudes	.095	.044	.117	-.010	.149	.065	.034	1.000	.097
	Peer_Influence	.236	.137	.001	-.045	.163	-.031	-.043	.097	1.000
Sig. (1-tailed)	Out school value	.	.011	.178	.198	.356	.063	.382	.101	<.001
	Gender	.011	.	.057	.454	.291	.262	.078	.281	.033
	EAL	.178	.057	.	.154	.000	.125	.064	.060	.494
	FSM	.198	.454	.154	.	.193	.040	.104	.447	.276
	ETH3=SOUTH ASIAN	.356	.291	.000	.193	.	.000	.293	.023	.014
	ETH3=BLACK	.063	.262	.125	.040	.000	.	.122	.192	.338
	TeacherGender_RECODE =Female	.382	.078	.064	.104	.293	.122	.	.326	.283
	Parent Positive Attitudes	.101	.281	.060	.447	.023	.192	.326	.	.097
	Peer_Influence	.001	.033	.494	.276	.014	.338	.283	.097	.
N	Out school value	180	180	180	180	180	180	180	180	180
	Gender	180	180	180	180	180	180	180	180	180
	EAL	180	180	180	180	180	180	180	180	180
	FSM	180	180	180	180	180	180	180	180	180
	ETH3=SOUTH ASIAN	180	180	180	180	180	180	180	180	180
	ETH3=BLACK	180	180	180	180	180	180	180	180	180
	TeacherGender_RECODE =Female	180	180	180	180	180	180	180	180	180
	Parent Positive Attitudes	180	180	180	180	180	180	180	180	180
	Peer_Influence	180	180	180	180	180	180	180	180	180

Coefficients[a]

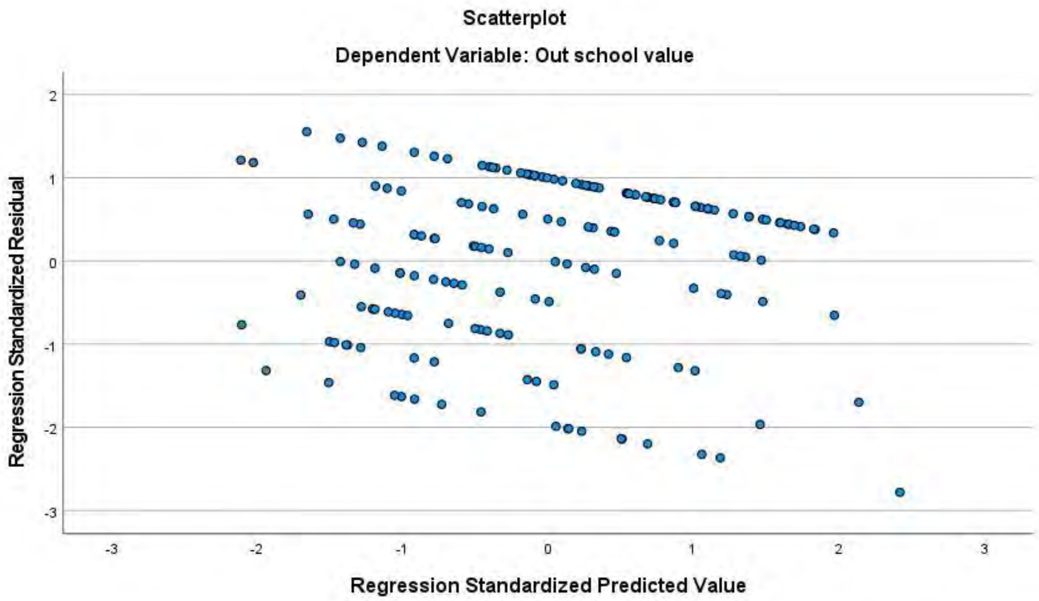
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	2.235	.667		3.351	<.001					
	Gender	.596	.313	.141	1.901	.059	.172	.144	.137	.953	1.049
	EAL	-.308	.377	-.073	-.816	.416	-.069	-.062	-.059	.660	1.515
	FSM	-.315	.359	-.065	-.879	.381	-.064	-.067	-.064	.957	1.045
	ETH3=SOUTH ASIAN	.024	.408	.005	.058	.954	-.028	.004	.004	.602	1.661
	ETH3=BLACK	.863	.495	.138	1.742	.083	.115	.132	.126	.832	1.201
	TeacherGender_RECODE =Female	-.094	.331	-.021	-.283	.777	-.023	-.022	-.020	.943	1.060
	Parent Positive Attitudes	.032	.035	.068	.914	.362	.095	.070	.066	.955	1.047
	Peer_Influence	.186	.066	.210	2.807	.006	.236	.210	.203	.933	1.071

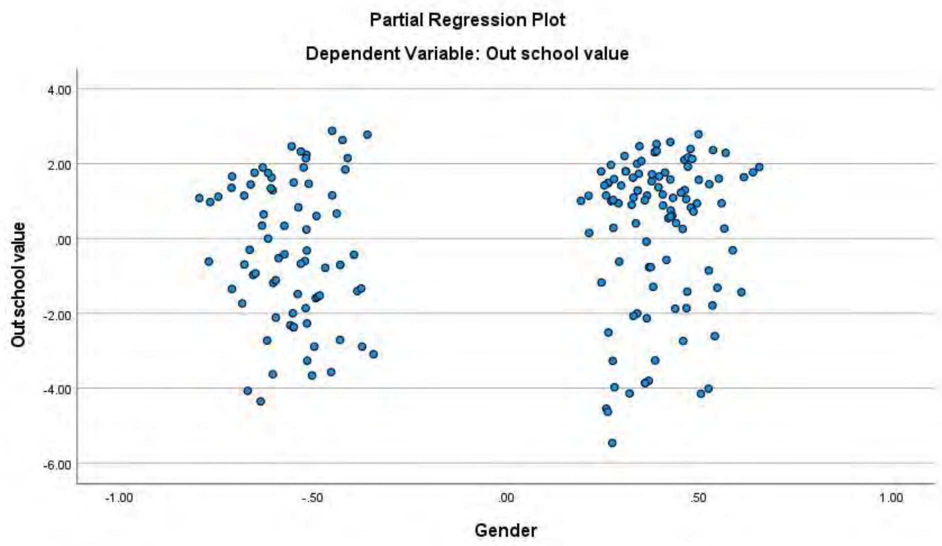
a. Dependent Variable: Out school value

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
1	1	5.525	1.000	.00	.01	.01	.01	.01	.00	.01	.00	.00
	2	1.065	2.278	.00	.00	.01	.08	.11	.38	.00	.00	.00
	3	.773	2.673	.00	.08	.20	.00	.07	.16	.04	.00	.00
	4	.681	2.849	.00	.01	.00	.86	.00	.14	.00	.00	.00
	5	.335	4.060	.00	.66	.05	.01	.00	.00	.34	.00	.00
	6	.247	4.731	.02	.18	.10	.00	.43	.24	.20	.03	.07
	7	.239	4.806	.00	.04	.56	.04	.35	.06	.30	.01	.07
	8	.099	7.485	.01	.00	.04	.00	.01	.00	.06	.39	.64
	9	.036	12.334	.96	.01	.02	.01	.02	.00	.06	.57	.22

a. Dependent Variable: Out school value




Partial Regression Plot
Dependent Variable: Out school value
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2.00
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-2.00
-4.00
-6.00
Out school value
-1.00
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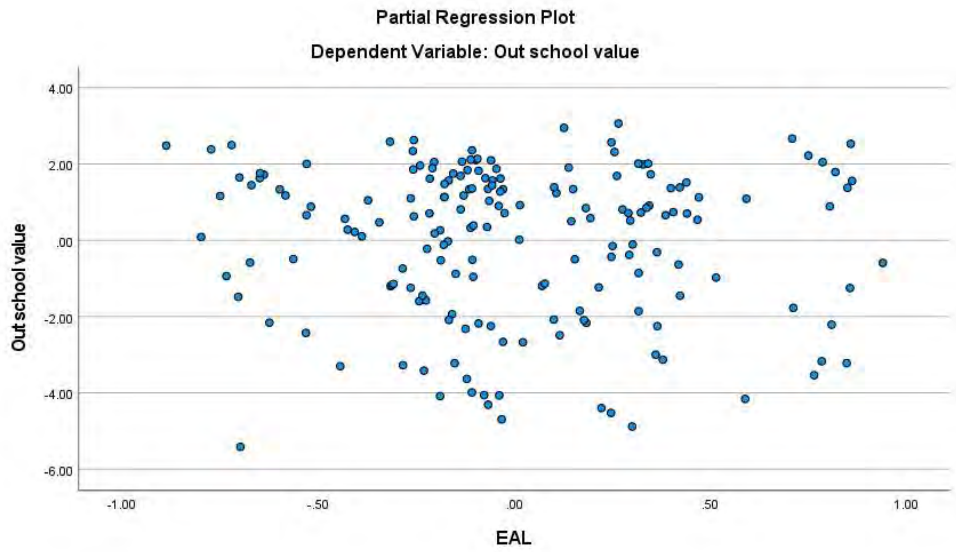
.00
.50
1.00
Gender


Partial Regression Plot
Dependent Variable: Out school value
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2.00
.00
-2.00
-4.00
-6.00
Out school value
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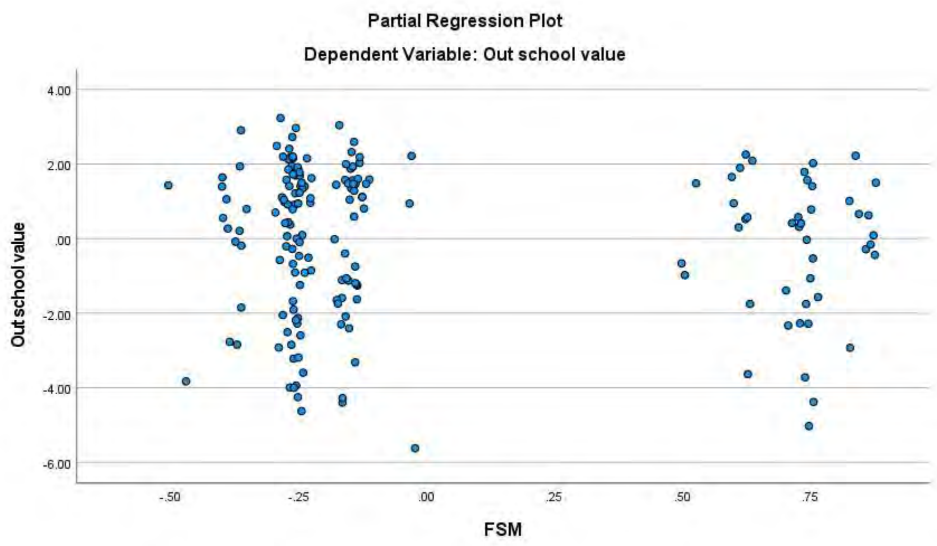
.00
.50
1.00
EAL


Partial Regression Plot
Dependent Variable: Out school value
4.00
2.00
.00
-2.00
-4.00
-6.00
Out school value
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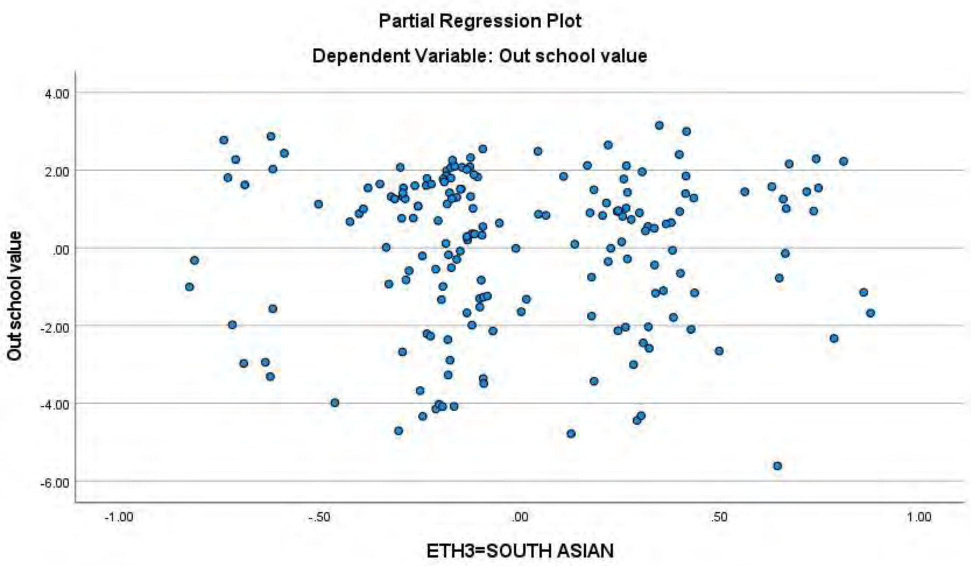
-.25
.00
.25
.50
.75
FSM


Partial Regression Plot
Dependent Variable: Out school value
Out school value
4.00
2.00
.00
-2.00
-4.00
-6.00
-1.00
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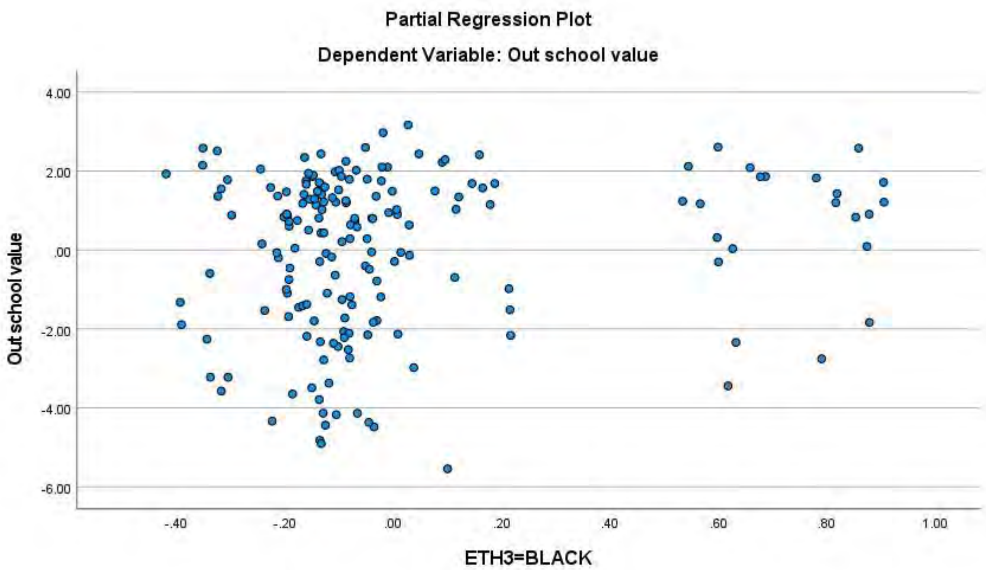
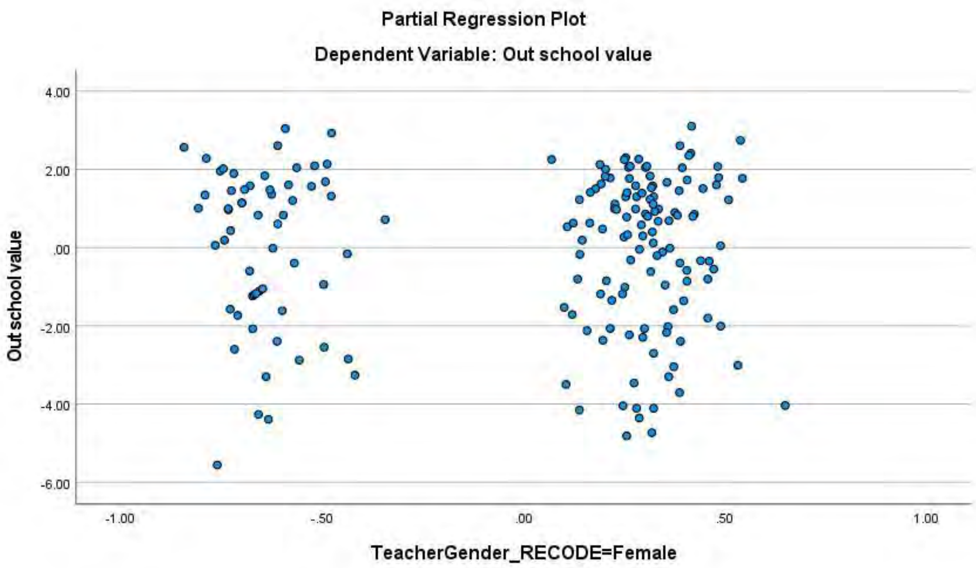
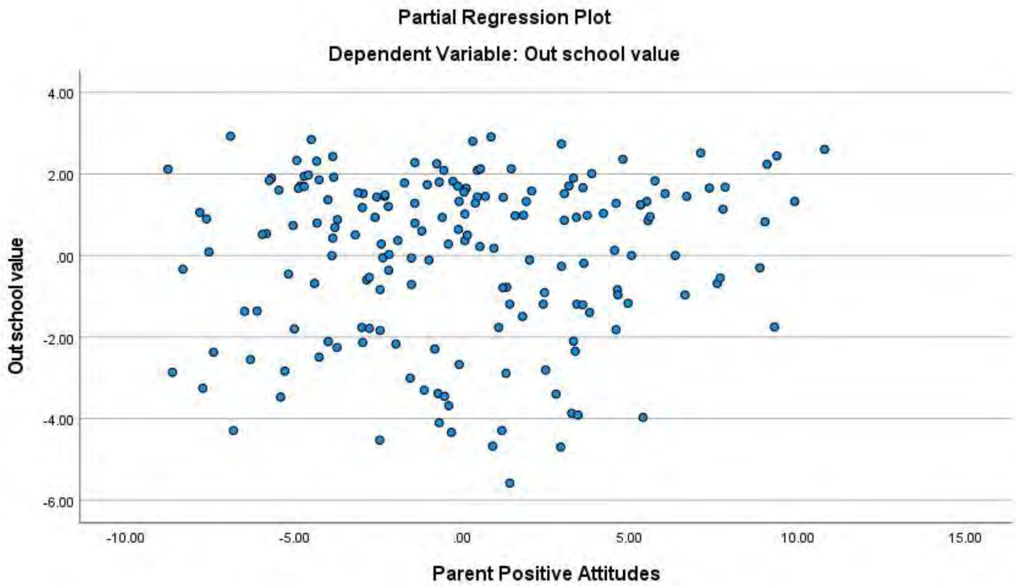
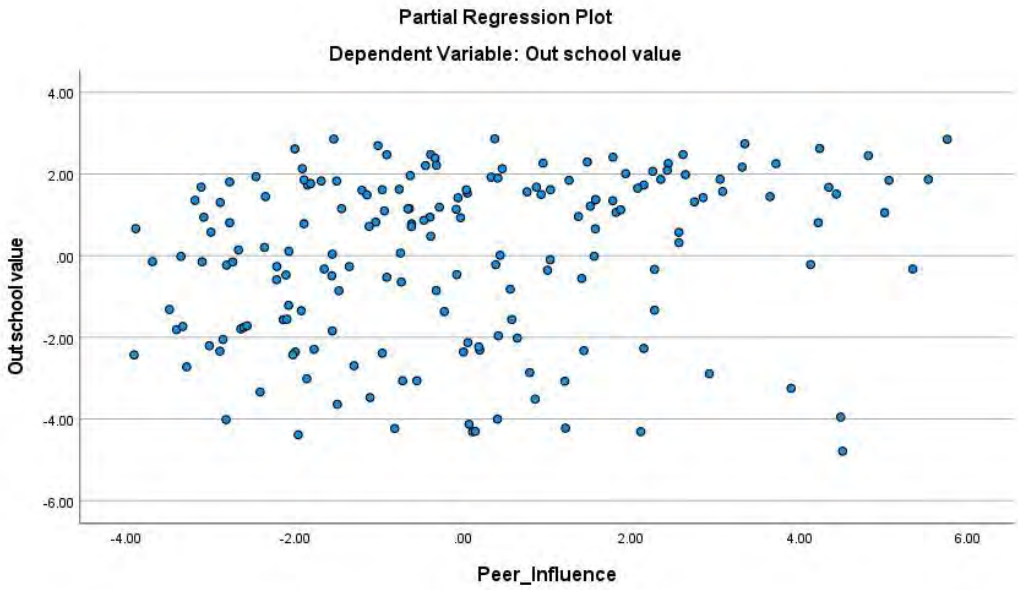
1.00
ETH3=SOUTH ASIAN


Partial Regression Plot
Dependent Variable: Out school value
Out school value
4.00
2.00
.00
-2.00
-4.00
-6.00
-.40
-.20
.00
.20
.40
.60
.80
1.00
ETH3=BLACK


Partial Regression Plot
Dependent Variable: Out school value
Out school value
4.00
2.00
.00
-2.00
-4.00
-6.00
-1.00
-.50
.00
.50
1.00
TeacherGender_RECODE=Female





Output

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.325[a]	.106	.064	2.02365

a. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

b. Dependent Variable: Out school value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	82.680	8	10.335	2.524	.013[b]
	Residual	700.270	171	4.095		
	Total	782.950	179			

a. Dependent Variable: Out school value

b. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2.235	.667		3.351	<.001					
	Gender	.596	.313	.141	1.901	.059	.172	.144	.137	.953	1.049
	EAL	-.308	.377	-.073	-.816	.416	-.069	-.062	-.059	.660	1.515
	FSM	-.315	.359	-.065	-.879	.381	-.064	-.067	-.064	.957	1.045
	ETH3=SOUTH ASIAN	.024	.408	.005	.058	.954	-.028	.004	.004	.602	1.661
	ETH3=BLACK	.863	.495	.138	1.742	.083	.115	.132	.126	.832	1.201
	TeacherGender_RECODE =Female	-.094	.331	-.021	-.283	.777	-.023	-.022	-.020	.943	1.060
	Parent Positive Attitudes	.032	.035	.068	.914	.362	.095	.070	.066	.955	1.047
	Peer_Influence	.186	.066	.210	2.807	.006	.236	.210	.203	.933	1.071

a. Dependent Variable: Out school value

Appendix D.3: Relevance

Parametric assumptions

Correlations

		Relevance	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
Pearson Correlation	Relevance	1.000	.059	.139	-.042	.099	.097	-.069	.214	.142
	Gender	.059	1.000	-.118	.009	-.041	-.048	.106	.044	.137
	EAL	.139	-.118	1.000	.076	.499	.086	-.114	.117	.001
	FSM	-.042	.009	.076	1.000	-.065	.131	.094	-.010	-.045
	ETH3=SOUTH ASIAN	.099	-.041	.499	-.065	1.000	-.281	.041	.149	.163
	ETH3=BLACK	.097	-.048	.086	.131	-.281	1.000	-.087	.065	-.031
	TeacherGender_RECODE =Female	-.069	.106	-.114	.094	.041	-.087	1.000	.034	-.043
	Parent Positive Attitudes	.214	.044	.117	-.010	.149	.065	.034	1.000	.097
	Peer_Influence	.142	.137	.001	-.045	.163	-.031	-.043	.097	1.000
Sig. (1-tailed)	Relevance	.	.216	.031	.289	.092	.098	.179	.002	.028
	Gender	.216	.	.057	.454	.291	.262	.078	.281	.033
	EAL	.031	.057	.	.154	.000	.125	.064	.060	.494
	FSM	.289	.454	.154	.	.193	.040	.104	.447	.276
	ETH3=SOUTH ASIAN	.092	.291	.000	.193	.	.000	.293	.023	.014
	ETH3=BLACK	.098	.262	.125	.040	.000	.	.122	.192	.338
	TeacherGender_RECODE =Female	.179	.078	.064	.104	.293	.122	.	.326	.283
	Parent Positive Attitudes	.002	.281	.060	.447	.023	.192	.326	.	.097
	Peer_Influence	.028	.033	.494	.276	.014	.338	.283	.097	.
N	Relevance	180	180	180	180	180	180	180	180	180
	Gender	180	180	180	180	180	180	180	180	180
	EAL	180	180	180	180	180	180	180	180	180
	FSM	180	180	180	180	180	180	180	180	180
	ETH3=SOUTH ASIAN	180	180	180	180	180	180	180	180	180
	ETH3=BLACK	180	180	180	180	180	180	180	180	180
	TeacherGender_RECODE =Female	180	180	180	180	180	180	180	180	180
	Parent Positive Attitudes	180	180	180	180	180	180	180	180	180
	Peer_Influence	180	180	180	180	180	180	180	180	180

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.538	.634		.850	.397					
	Gender	.237	.298	.060	.797	.427	.059	.061	.058	.953	1.049
	EAL	.389	.358	.097	1.085	.280	.139	.083	.079	.660	1.515
	FSM	-.219	.341	-.048	-.643	.521	-.042	-.049	-.047	.957	1.045
	ETH3=SOUTH ASIAN	.140	.387	.034	.362	.718	.099	.028	.026	.602	1.661
	ETH3=BLACK	.553	.470	.094	1.176	.241	.097	.090	.086	.832	1.201
	TeacherGender_RECODE =Female	-.226	.314	-.054	-.719	.473	-.069	-.055	-.052	.943	1.060
	Parent Positive Attitudes	.079	.033	.179	2.400	.017	.214	.181	.175	.955	1.047
	Peer_Influence	.091	.063	.110	1.451	.149	.142	.110	.106	.933	1.071

a. Dependent Variable: Relevance

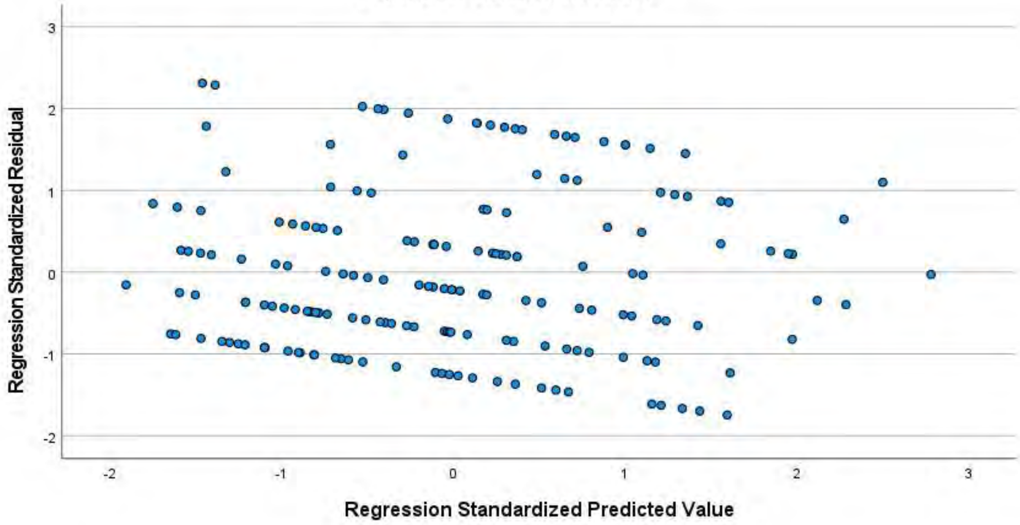
Collinearity Diagnostics[a]

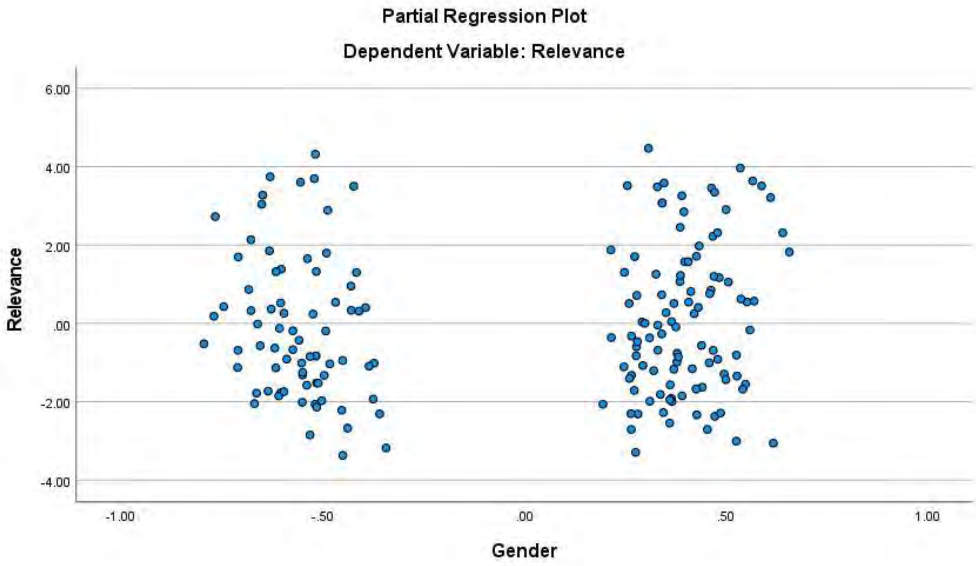
Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
1	1	5.525	1.000	.00	.01	.01	.01	.01	.00	.01	.00	.00
	2	1.065	2.278	.00	.00	.01	.08	.11	.38	.00	.00	.00
	3	.773	2.673	.00	.08	.20	.00	.07	.16	.04	.00	.00
	4	.681	2.849	.00	.01	.00	.86	.00	.14	.00	.00	.00
	5	.335	4.060	.00	.66	.05	.01	.00	.00	.34	.00	.00
	6	.247	4.731	.02	.18	.10	.00	.43	.24	.20	.03	.07
	7	.239	4.806	.00	.04	.56	.04	.35	.06	.30	.01	.07
	8	.099	7.485	.01	.00	.04	.00	.01	.00	.06	.39	.64
	9	.036	12.334	.96	.01	.02	.01	.02	.00	.06	.57	.22

a. Dependent Variable: Relevance

Scatterplot

Dependent Variable: Relevance





Partial Regression Plot
Dependent Variable: Relevance
Relevance
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2.00
.00
-2.00
-4.00
-1.00
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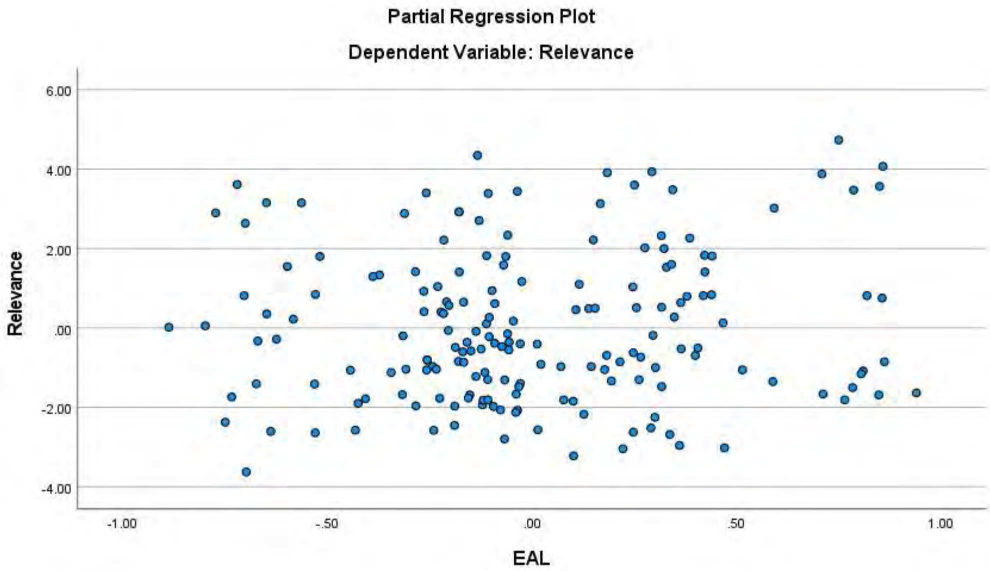
.00
.50
1.00
Gender



Partial Regression Plot
Dependent Variable: Relevance
Relevance
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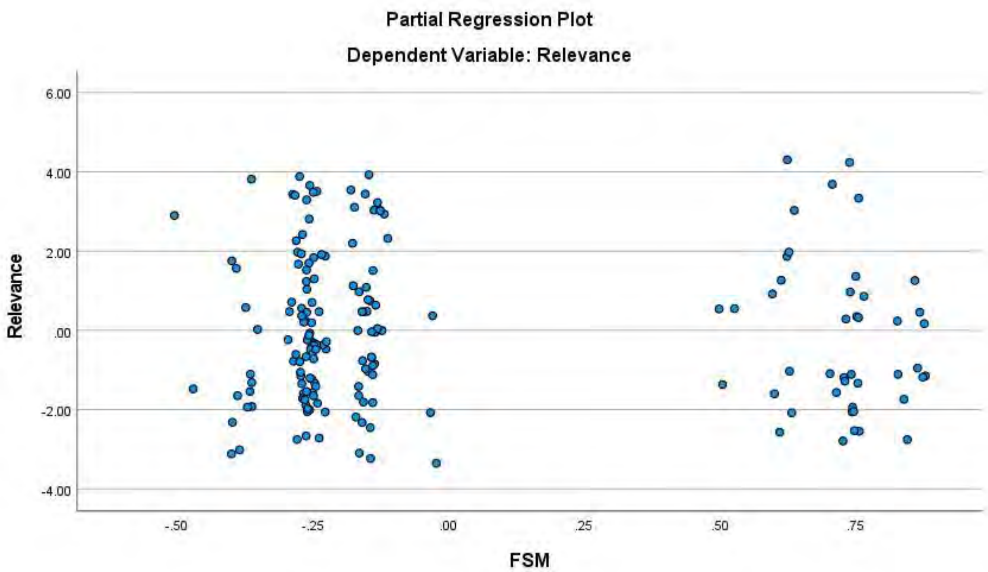
4.00
2.00
.00
-2.00
-4.00
-1.00
-.50
.00
.50
1.00
EAL



Partial Regression Plot
Dependent Variable: Relevance
Relevance
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4.00
2.00
.00
-2.00
-4.00
-.50
-.25
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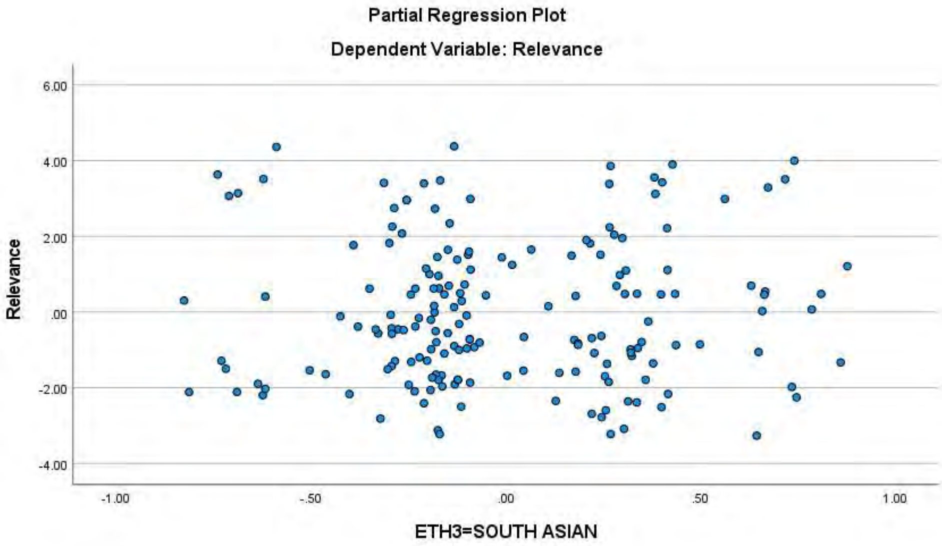
.25
.50
.75
FSM


Partial Regression Plot
Dependent Variable: Relevance
Relevance
6.00
4.00
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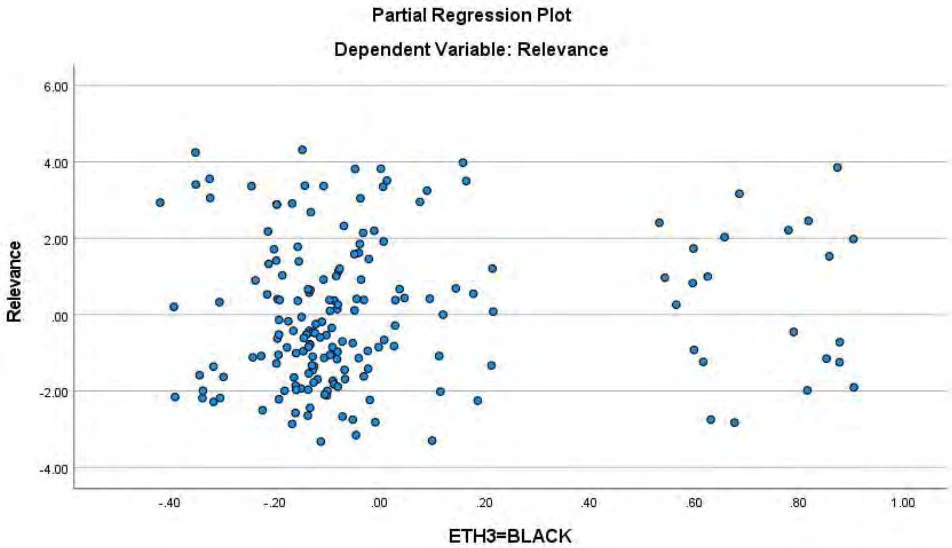
.00
.50
1.00
ETH3=SOUTH ASIAN


Partial Regression Plot
Dependent Variable: Relevance
Relevance
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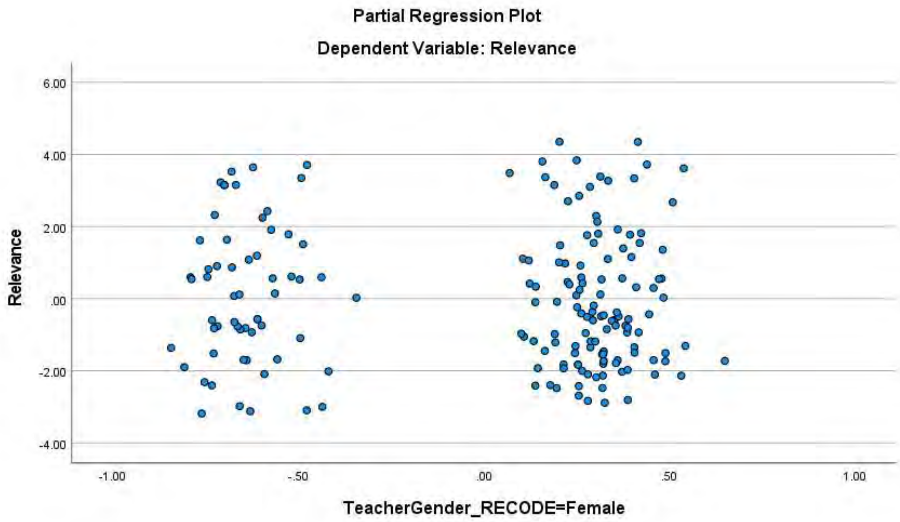
-4.00
-.40
-.20
.00
.20
.40
.60
.80
1.00
ETH3=BLACK


Partial Regression Plot
Dependent Variable: Relevance
Relevance
6.00
4.00
2.00
.00
-2.00
-4.00
-1.00
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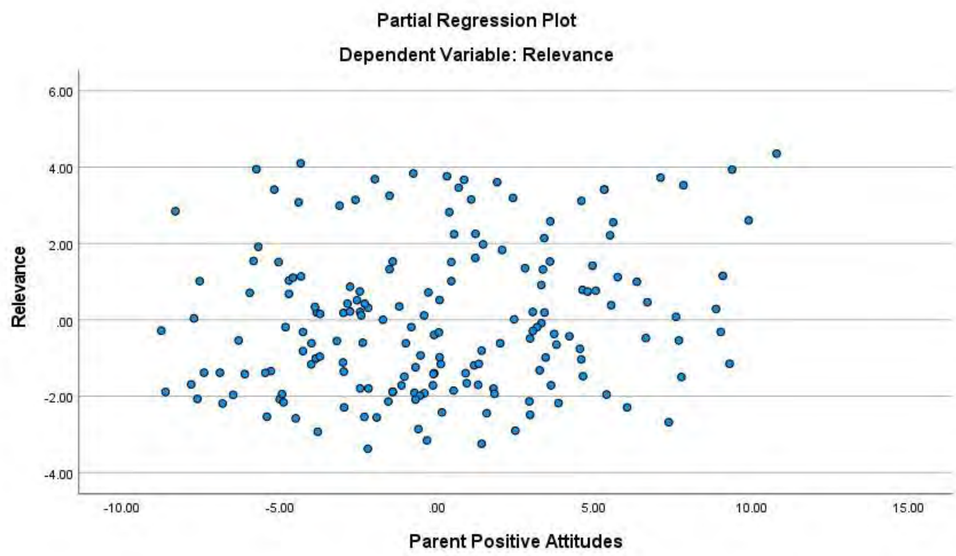
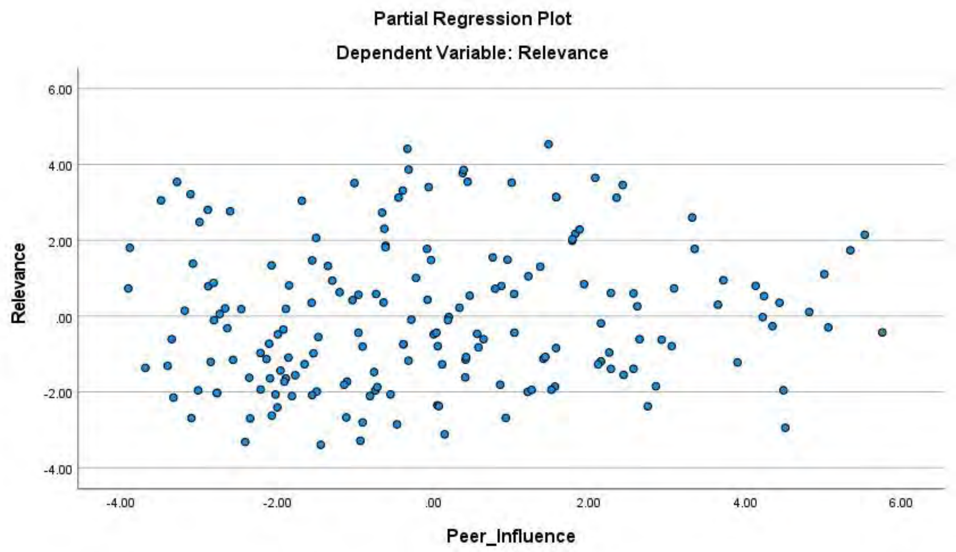
.50
1.00
TeacherGender_RECODE=Female





Output

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.299[a]	.089	.047	1.92231

a. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

b. Dependent Variable: Relevance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61.856	8	7.732	2.092	.039[b]
	Residual	631.894	171	3.695		
	Total	693.750	179			

a. Dependent Variable: Relevance

b. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.538	.634		.850	.397					
	Gender	.237	.298	.060	.797	.427	.059	.061	.058	.953	1.049
	EAL	.389	.358	.097	1.085	.280	.139	.083	.079	.660	1.515
	FSM	-.219	.341	-.048	-.643	.521	-.042	-.049	-.047	.957	1.045
	ETH3=SOUTH ASIAN	.140	.387	.034	.362	.718	.099	.028	.026	.602	1.661
	ETH3=BLACK	.553	.470	.094	1.176	.241	.097	.090	.086	.832	1.201
	TeacherGender_RECODE =Female	-.226	.314	-.054	-.719	.473	-.069	-.055	-.052	.943	1.060
	Parent Positive Attitudes	.079	.033	.179	2.400	.017	.214	.181	.175	.955	1.047
	Peer_Influence	.091	.063	.110	1.451	.149	.142	.110	.106	.933	1.071

a. Dependent Variable: Relevance

Appendix D.4: Confidence

Parametric assumptions

Correlations

		Confidence	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
Pearson Correlation	Confidence	1.000	.256	-.026	.072	.187	.006	.071	.100	.241
	Gender	.256	1.000	-.115	.011	-.038	-.046	.114	.051	.144
	EAL	-.026	-.115	1.000	.074	.498	.084	-.122	.111	-.005
	FSM	.072	.011	.074	1.000	-.068	.130	.090	-.015	-.049
	ETH3=SOUTH ASIAN	.187	-.038	.498	-.068	1.000	-.283	.035	.145	.159
	ETH3=BLACK	.006	-.046	.084	.130	-.283	1.000	-.091	.063	-.034
	TeacherGender_RECODE =Female	.071	.114	-.122	.090	.035	-.091	1.000	.023	-.053
	Parent Positive Attitudes	.100	.051	.111	-.015	.145	.063	.023	1.000	.088
	Peer_Influence	.241	.144	-.005	-.049	.159	-.034	-.053	.088	1.000
Sig. (1-tailed)	Confidence	.	<.001	.366	.168	.006	.466	.171	.091	<.001
	Gender	.000	.	.063	.439	.307	.270	.065	.250	.027
	EAL	.366	.063	.	.162	.000	.130	.052	.070	.475
	FSM	.168	.439	.162	.	.185	.042	.115	.423	.259
	ETH3=SOUTH ASIAN	.006	.307	.000	.185	.	.000	.319	.027	.017
	ETH3=BLACK	.466	.270	.130	.042	.000	.	.113	.203	.325
	TeacherGender_RECODE =Female	.171	.065	.052	.115	.319	.113	.	.381	.239
	Parent Positive Attitudes	.091	.250	.070	.423	.027	.203	.381	.	.119
	Peer_Influence	.001	.027	.475	.259	.017	.325	.239	.119	.
N	Confidence	179	179	179	179	179	179	179	179	179
	Gender	179	179	179	179	179	179	179	179	179
	EAL	179	179	179	179	179	179	179	179	179
	FSM	179	179	179	179	179	179	179	179	179
	ETH3=SOUTH ASIAN	179	179	179	179	179	179	179	179	179
	ETH3=BLACK	179	179	179	179	179	179	179	179	179
	TeacherGender_RECODE =Female	179	179	179	179	179	179	179	179	179
	Parent Positive Attitudes	179	179	179	179	179	179	179	179	179
	Peer_Influence	179	179	179	179	179	179	179	179	179

Coefficients[a]

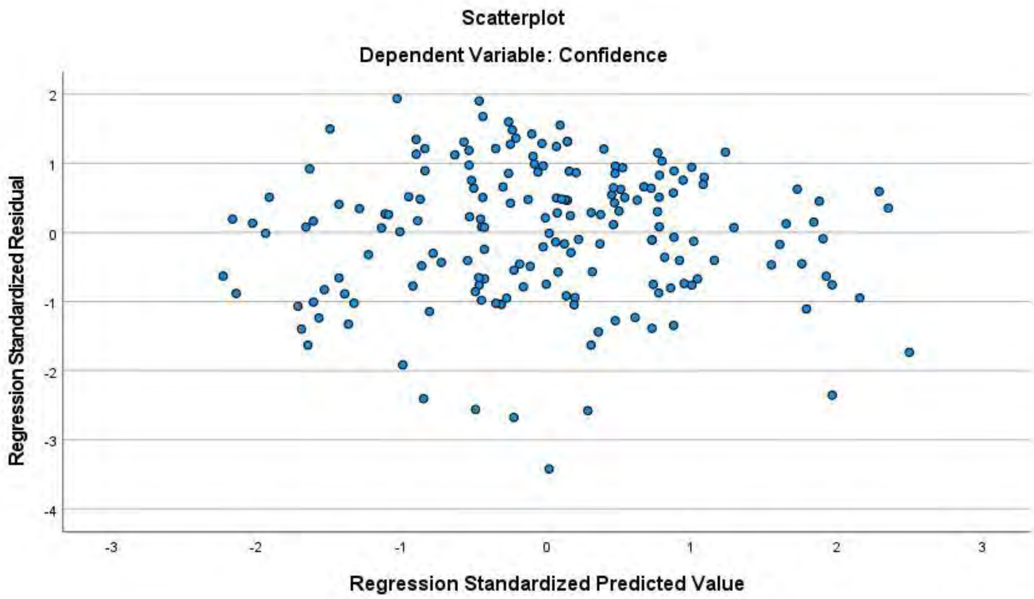
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	33.612	3.141		10.700	<.001					
	Gender	4.524	1.459	.223	3.100	.002	.256	.231	.217	.950	1.053
	EAL	-3.064	1.752	-.151	-1.749	.082	-.026	-.133	-.122	.661	1.512
	FSM	2.158	1.665	.093	1.296	.197	.072	.099	.091	.958	1.044
	ETH3=SOUTH ASIAN	5.655	1.891	.270	2.990	.003	.187	.224	.209	.604	1.656
	ETH3=BLACK	2.965	2.298	.099	1.290	.199	.006	.098	.090	.833	1.201
	TeacherGender_RECODE =Female	.575	1.546	.027	.372	.710	.071	.029	.026	.940	1.064
	Parent Positive Attitudes	.104	.161	.046	.646	.519	.100	.050	.045	.958	1.044
	Peer_Influence	.727	.310	.170	2.349	.020	.241	.177	.165	.932	1.073

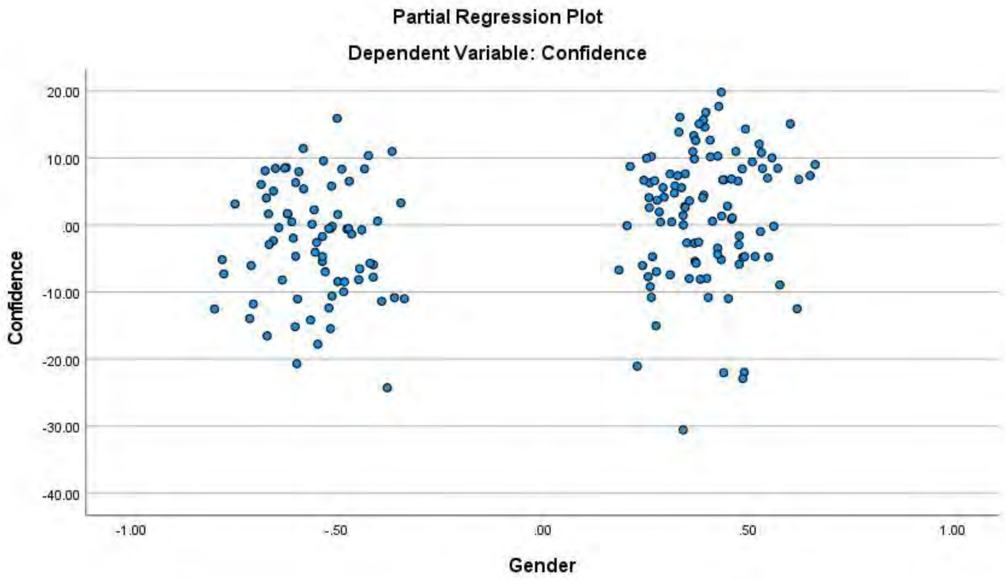
a. Dependent Variable: Confidence

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
1	1	5.530	1.000	.00	.01	.01	.01	.01	.00	.01	.00	.00
	2	1.065	2.279	.00	.00	.01	.08	.11	.38	.00	.00	.00
	3	.771	2.678	.00	.08	.20	.00	.07	.17	.04	.00	.00
	4	.680	2.851	.00	.01	.00	.86	.00	.14	.00	.00	.00
	5	.333	4.073	.00	.69	.05	.01	.00	.00	.32	.00	.00
	6	.247	4.731	.02	.17	.10	.00	.43	.24	.21	.03	.07
	7	.239	4.807	.00	.04	.57	.04	.36	.06	.29	.01	.07
	8	.099	7.493	.01	.00	.04	.00	.01	.00	.06	.39	.63
	9	.035	12.484	.96	.00	.02	.01	.02	.00	.07	.57	.23

a. Dependent Variable: Confidence




Partial Regression Plot
Dependent Variable: Confidence
Confidence
20.00
10.00
.00
-10.00
-20.00
-30.00
-40.00
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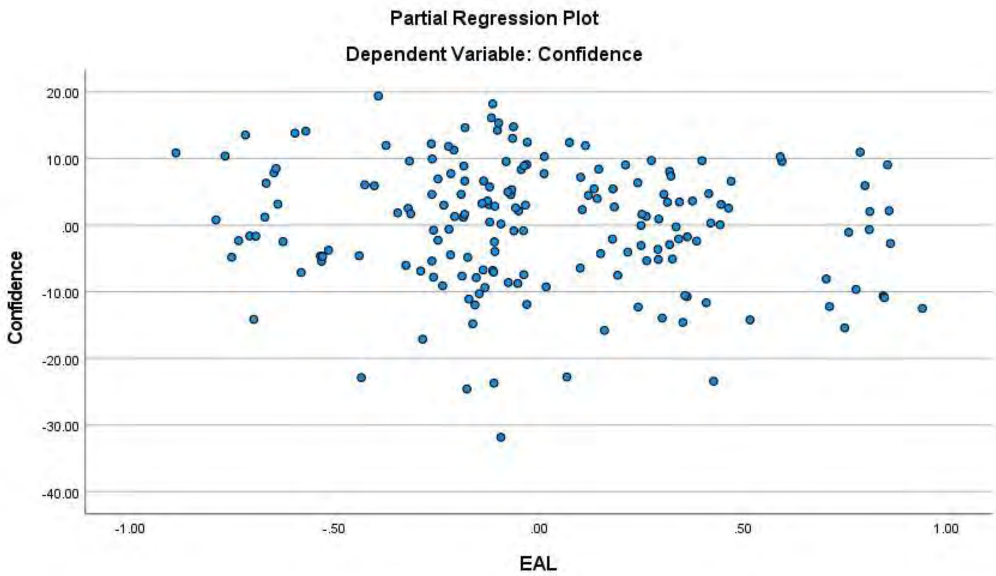
.00
.50
1.00
Gender


Partial Regression Plot
Dependent Variable: Confidence
Confidence
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10.00
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-10.00
-20.00
-30.00
-40.00
-1.00
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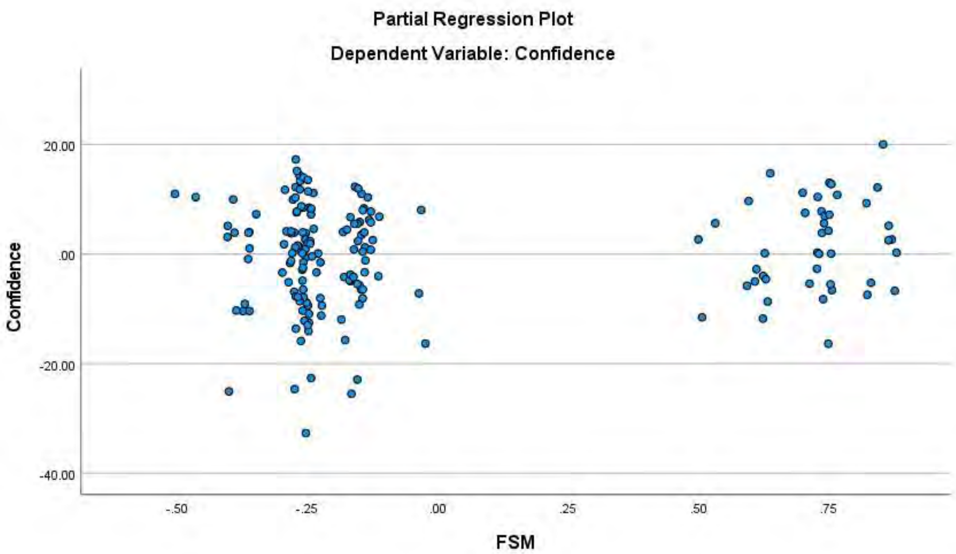
.00
.50
1.00
EAL


Partial Regression Plot
Dependent Variable: Confidence
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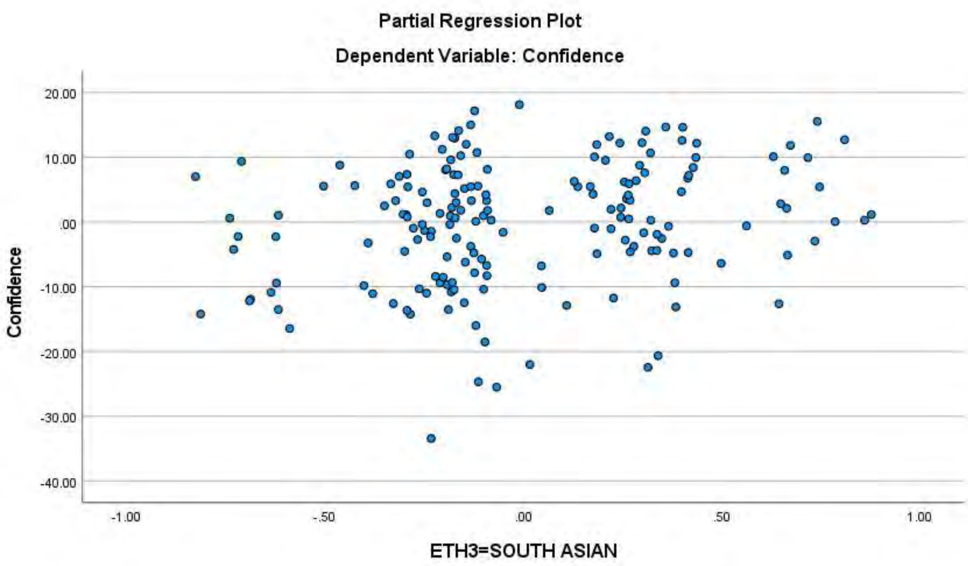
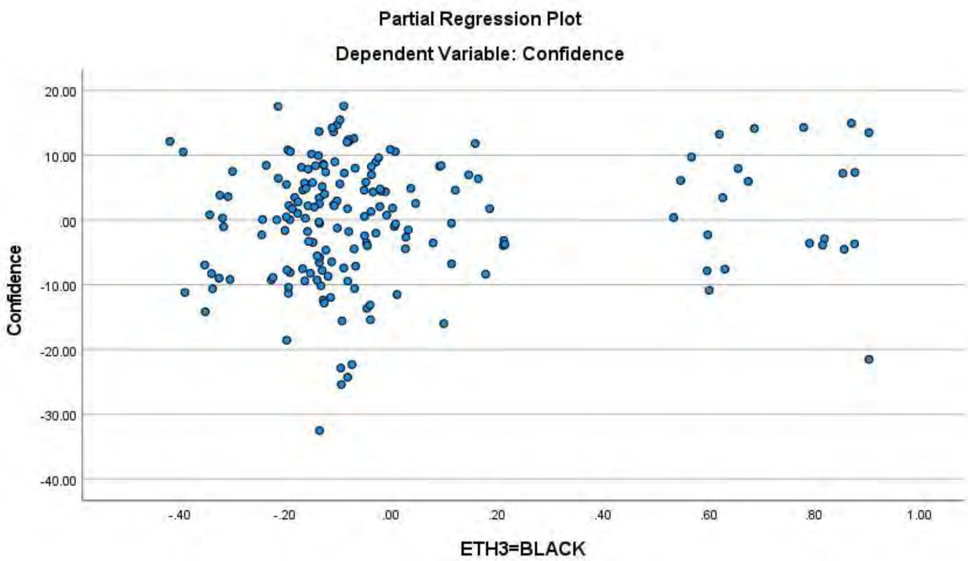
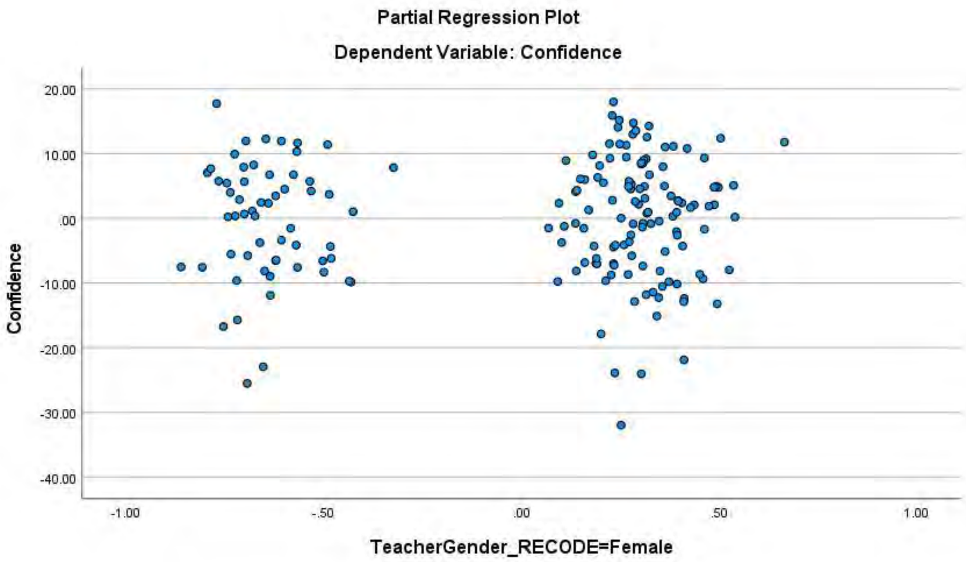
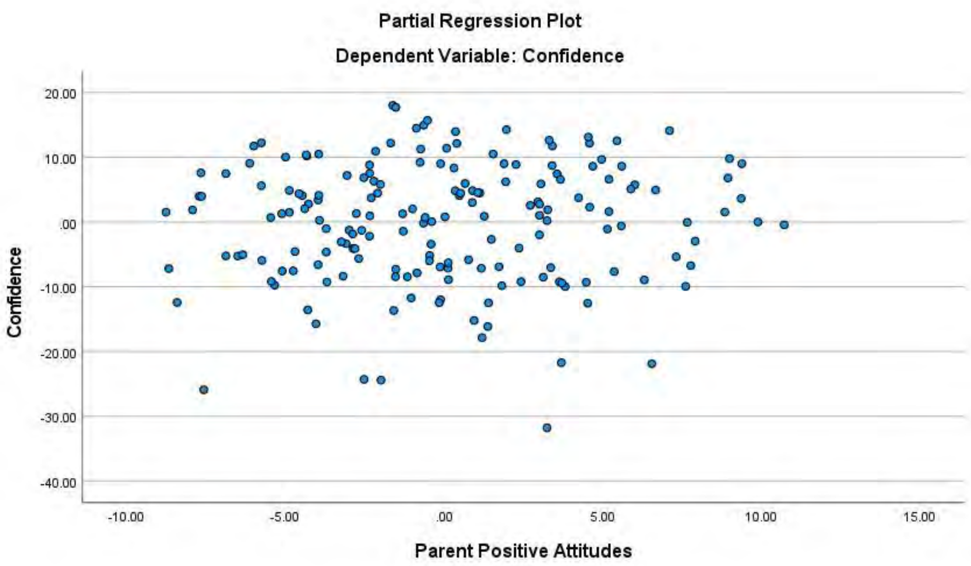
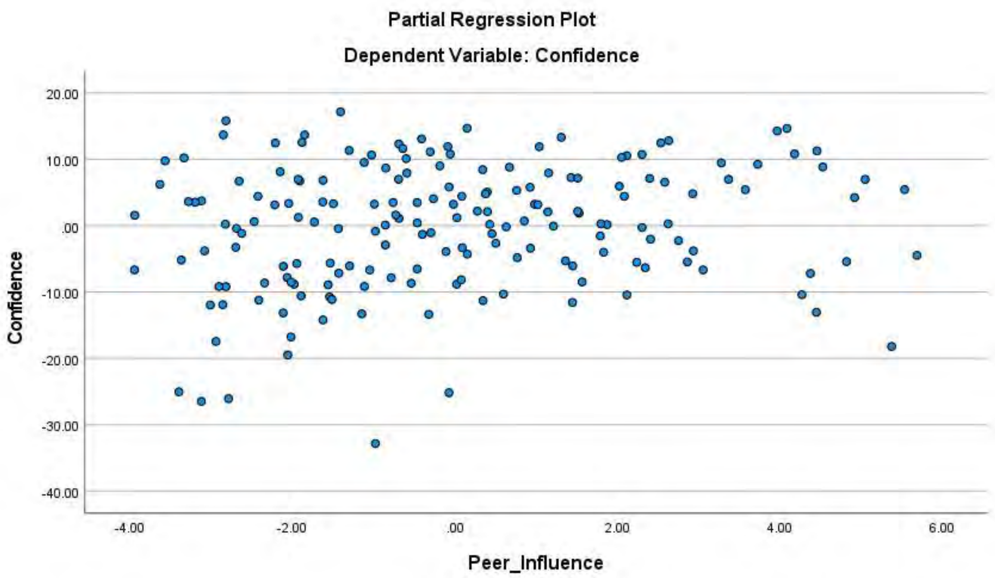
-40.00
-.50
-.25
.00
.25
.50
.75
FSM


Partial Regression Plot
Dependent Variable: Confidence
Confidence
20.00
10.00
.00
-10.00
-20.00
-30.00
-40.00
-1.00
-.50
.00
.50
1.00
ETH3=SOUTH ASIAN


Partial Regression Plot
Dependent Variable: Confidence
Confidence
20.00
10.00
.00
-10.00
-20.00
-30.00
-40.00
-.40
-.20
.00
.20
.40
.60
.80
1.00
ETH3=BLACK


Partial Regression Plot
Dependent Variable: Confidence
Confidence
20.00
10.00
.00
-10.00
-20.00
-30.00
-40.00
-1.00
-.50
.00
.50
1.00
TeacherGender_RECODE=Female





Output

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.408[a]	.166	.127	9.38885

a. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

b. Dependent Variable: Confidence

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2986.962	8	373.370	4.236	<.001 [b]
	Residual	14985.586	170	88.151		
	Total	17972.547	178			

ANOVA [a]

a. Dependent Variable: Confidence

b. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

Coefficients [a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	33.612	3.141		10.700	<.001					
	Gender	4.524	1.459	.223	3.100	.002	.256	.231	.217	.950	1.053
	EAL	-3.064	1.752	-.151	-1.749	.082	-.026	-.133	-.122	.661	1.512
	FSM	2.158	1.665	.093	1.296	.197	.072	.099	.091	.958	1.044
	ETH3=SOUTH ASIAN	5.655	1.891	.270	2.990	.003	.187	.224	.209	.604	1.656
	ETH3=BLACK	2.965	2.298	.099	1.290	.199	.006	.098	.090	.833	1.201
	TeacherGender_RECODE =Female	.575	1.546	.027	.372	.710	.071	.029	.026	.940	1.064
	Parent Positive Attitudes	.104	.161	.046	.646	.519	.100	.050	.045	.958	1.044
	Peer_Influence	.727	.310	.170	2.349	.020	.241	.177	.165	.932	1.073

a. Dependent Variable: Confidence

Appendix D.5: Mathematical Habitus

Parametric assumptions

Correlations

		Mathematical_Dispositions	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
Pearson Correlation	Mathematical_Dispositions	1.000	.233	.002	.055	.187	.043	.071	.168	.291
	Gender	.233	1.000	-.118	.009	-.041	-.048	.106	.044	.137
	EAL	.002	-.118	1.000	.076	.499	.086	-.114	.117	.001
	FSM	.055	.009	.076	1.000	-.065	.131	.094	-.010	-.045
	ETH3=SOUTH ASIAN	.187	-.041	.499	-.065	1.000	-.281	.041	.149	.163
	ETH3=BLACK	.043	-.048	.086	.131	-.281	1.000	-.087	.065	-.031
	TeacherGender_RECODE =Female	.071	.106	-.114	.094	.041	-.087	1.000	.034	-.043
	Parent Positive Attitudes	.168	.044	.117	-.010	.149	.065	.034	1.000	.097
	Peer_Influence	.291	.137	.001	-.045	.163	-.031	-.043	.097	1.000
Sig. (1-tailed)	Mathematical_Dispositions	.	<.001	.489	.234	.006	.281	.172	.012	<.001
	Gender	.001	.	.057	.454	.291	.262	.078	.281	.033
	EAL	.489	.057	.	.154	.000	.125	.064	.060	.494
	FSM	.234	.454	.154	.	.193	.040	.104	.447	.276
	ETH3=SOUTH ASIAN	.006	.291	.000	.193	.	.000	.293	.023	.014
	ETH3=BLACK	.281	.262	.125	.040	.000	.	.122	.192	.338
	TeacherGender_RECODE =Female	.172	.078	.064	.104	.293	.122	.	.326	.283
	Parent Positive Attitudes	.012	.281	.060	.447	.023	.192	.326	.	.097
	Peer_Influence	.000	.033	.494	.276	.014	.338	.283	.097	.
N	Mathematical_Dispositions	180	180	180	180	180	180	180	180	180
	Gender	180	180	180	180	180	180	180	180	180
	EAL	180	180	180	180	180	180	180	180	180
	FSM	180	180	180	180	180	180	180	180	180
	ETH3=SOUTH ASIAN	180	180	180	180	180	180	180	180	180
	ETH3=BLACK	180	180	180	180	180	180	180	180	180
	TeacherGender_RECODE =Female	180	180	180	180	180	180	180	180	180
	Parent Positive Attitudes	180	180	180	180	180	180	180	180	180
	Peer_Influence	180	180	180	180	180	180	180	180	180

Coefficients[a]

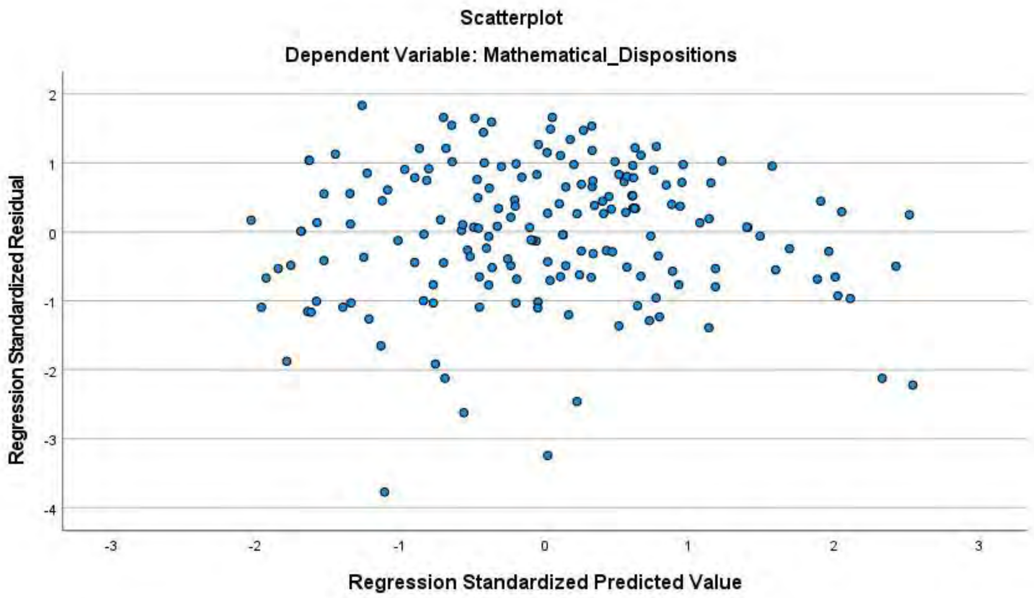
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	39.238	3.752		10.458	<.001					
	Gender	4.848	1.763	.195	2.751	.007	.233	.206	.190	.953	1.049
	EAL	-2.984	2.123	-.119	-1.406	.162	.002	-.107	-.097	.660	1.515
	FSM	1.967	2.019	.069	.974	.331	.055	.074	.067	.957	1.045
	ETH3=SOUTH ASIAN	6.186	2.293	.240	2.698	.008	.187	.202	.186	.602	1.661
	ETH3=BLACK	4.590	2.786	.125	1.648	.101	.043	.125	.114	.832	1.201
	TeacherGender_RECODE =Female	.971	1.861	.037	.521	.603	.071	.040	.036	.943	1.060
	Parent Positive Attitudes	.297	.195	.108	1.523	.130	.168	.116	.105	.955	1.047
	Peer_Influence	1.165	.373	.223	3.120	.002	.291	.232	.215	.933	1.071

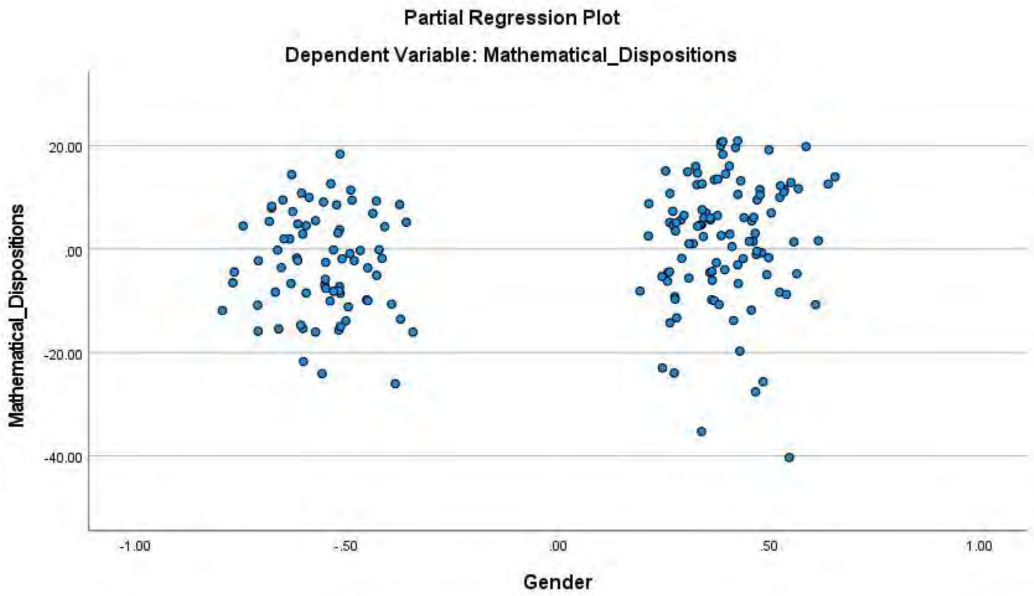
a. Dependent Variable: Mathematical_Dispositions

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Gender	EAL	FSM	ETH3=SOUTH ASIAN	ETH3=BLACK	TeacherGender_RECODE=Female	Parent Positive Attitudes	Peer_Influence
1	1	5.525	1.000	.00	.01	.01	.01	.01	.00	.01	.00	.00
	2	1.065	2.278	.00	.00	.01	.08	.11	.38	.00	.00	.00
	3	.773	2.673	.00	.08	.20	.00	.07	.16	.04	.00	.00
	4	.681	2.849	.00	.01	.00	.86	.00	.14	.00	.00	.00
	5	.335	4.060	.00	.66	.05	.01	.00	.00	.34	.00	.00
	6	.247	4.731	.02	.18	.10	.00	.43	.24	.20	.03	.07
	7	.239	4.806	.00	.04	.56	.04	.35	.06	.30	.01	.07
	8	.099	7.485	.01	.00	.04	.00	.01	.00	.06	.39	.64
	9	.036	12.334	.96	.01	.02	.01	.02	.00	.06	.57	.22

a. Dependent Variable: Mathematical_Dispositions




Partial Regression Plot
Dependent Variable: Mathematical_Dispositions
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-40.00
-1.00
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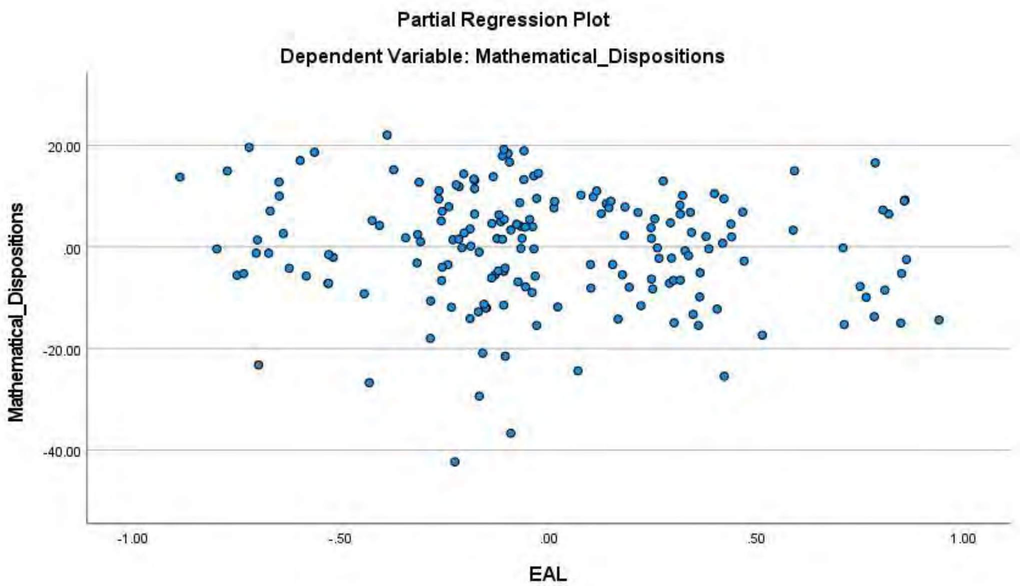
.00
.50
1.00
Gender


Partial Regression Plot
Dependent Variable: Mathematical_Dispositions
Mathematical_Dispositions
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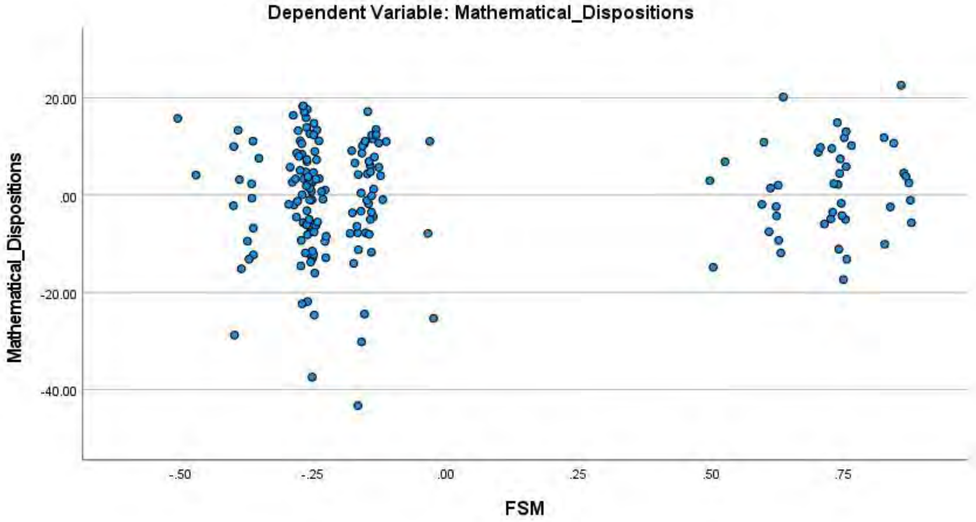
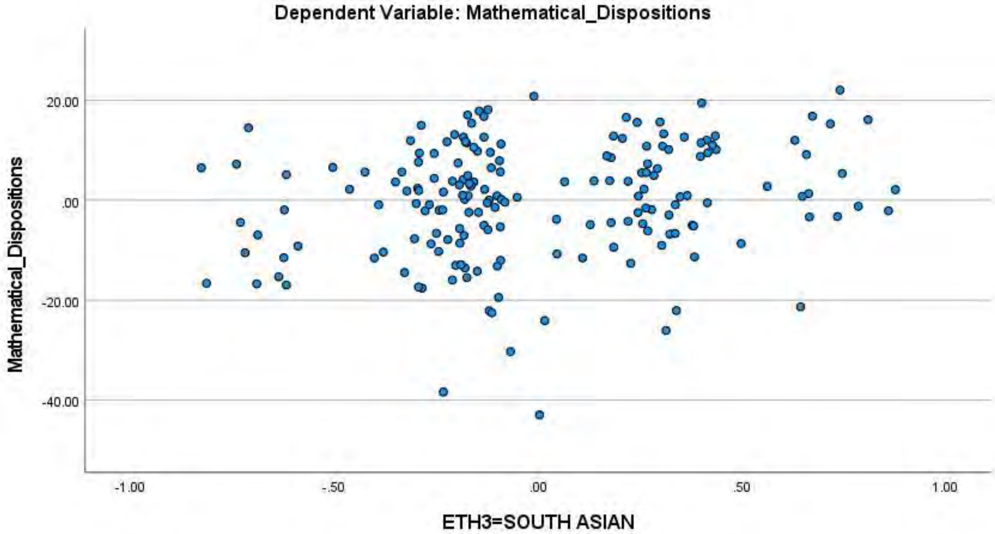
-40.00
-1.00
-.50
.00
.50
1.00
EAL

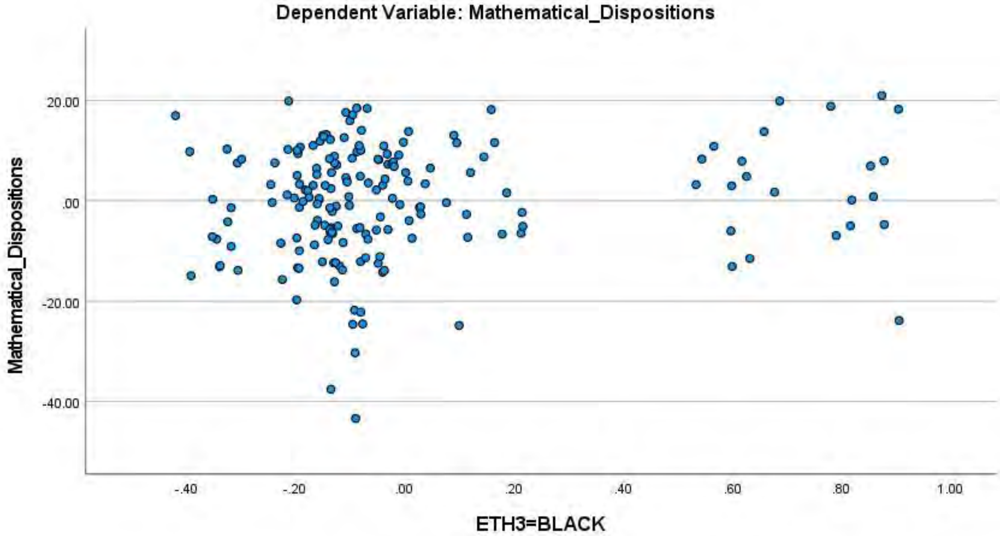
Partial Regression Plot
Dependent Variable: Mathematical_Dispositions

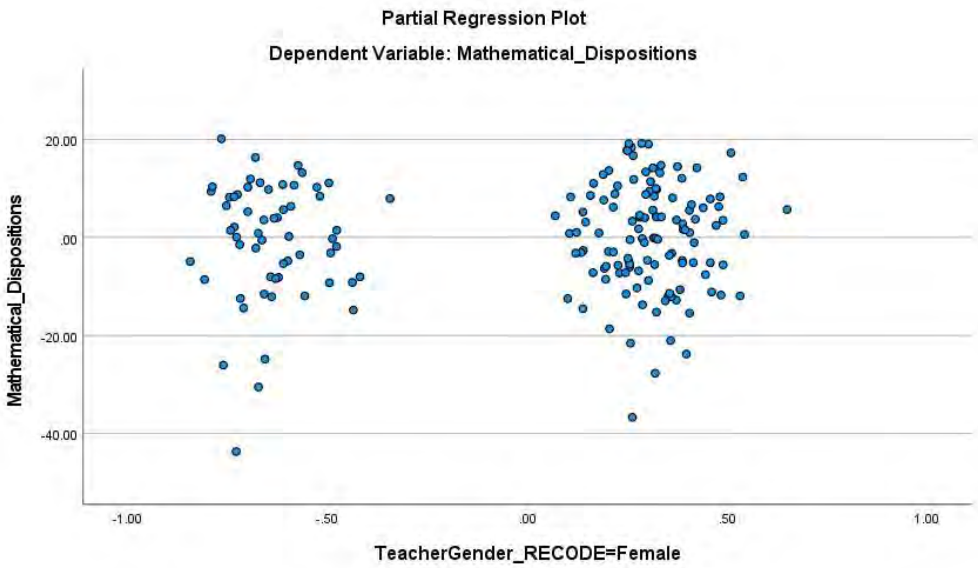


Partial Regression Plot
Dependent Variable: Mathematical_Dispositions



Partial Regression Plot
Dependent Variable: Mathematical_Dispositions




Partial Regression Plot
Dependent Variable: Mathematical_Dispositions
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.50
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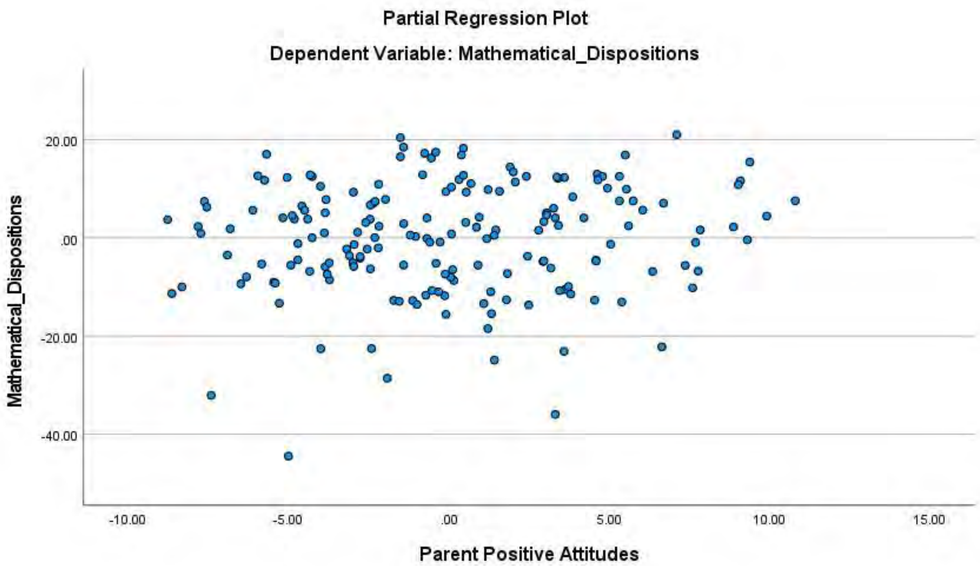
Partial Regression Plot
Dependent Variable: Mathematical_Dispositions
Mathematical_Dispositions
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-20.00
-40.00
-10.00
-5.00
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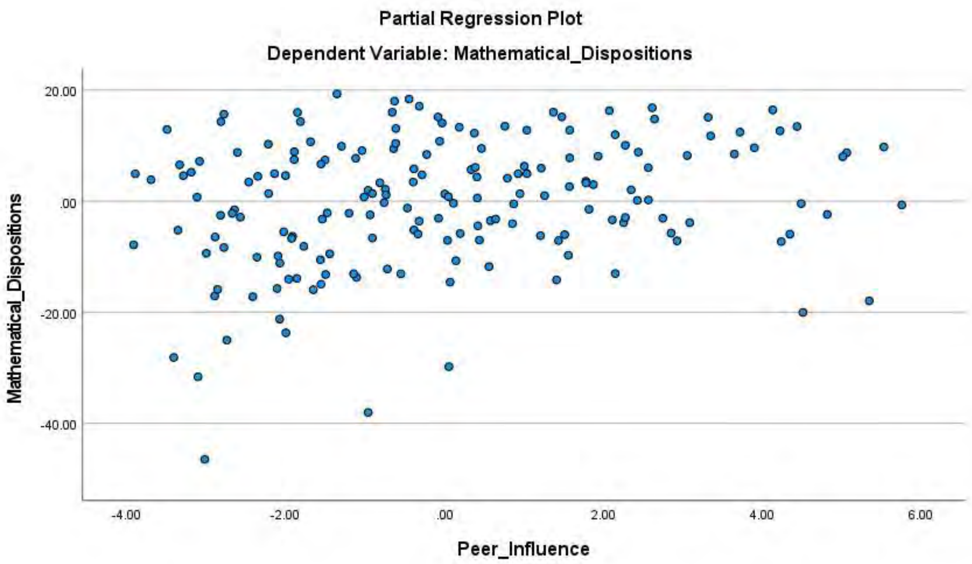
10.00
15.00
Parent Positive Attitudes


Partial Regression Plot
Dependent Variable: Mathematical_Dispositions
Mathematical_Dispositions
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.00
-20.00
-40.00
-4.00
-2.00
.00
2.00
4.00
6.00
Peer_Influence

Output

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.430[a]	.185	.147	11.38419

a. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

b. Dependent Variable: Mathematical_Dispositions

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5018.745	8	627.343	4.841	<.001[b]
	Residual	22161.566	171	129.600		
	Total	27180.311	179			

a. Dependent Variable: Mathematical_Dispositions

b. Predictors: (Constant), Peer_Influence, EAL, FSM, Parent Positive Attitudes, ETH3=BLACK, Gender, TeacherGender_RECODE=Female, ETH3=SOUTH ASIAN

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	39.238	3.752		10.458	<.001					
	Gender	4.848	1.763	.195	2.751	.007	.233	.206	.190	.953	1.049
	EAL	-2.984	2.123	-.119	-1.406	.162	.002	-.107	-.097	.660	1.515
	FSM	1.967	2.019	.069	.974	.331	.055	.074	.067	.957	1.045
	ETH3=SOUTH ASIAN	6.186	2.293	.240	2.698	.008	.187	.202	.186	.602	1.661
	ETH3=BLACK	4.590	2.786	.125	1.648	.101	.043	.125	.114	.832	1.201
	TeacherGender_RECODE =Female	.971	1.861	.037	.521	.603	.071	.040	.036	.943	1.060
	Parent Positive Attitudes	.297	.195	.108	1.523	.130	.168	.116	.105	.955	1.047
	Peer_Influence	1.165	.373	.223	3.120	.002	.291	.232	.215	.933	1.071

a. Dependent Variable: Mathematical_Dispositions

Appendix F: Multi-Level Model

Model 1

Information Criteria[a]

-2 Restricted Log Likelihood	13365.096305
Akaike's Information Criterion (AIC)	13369.096305
Hurvich and Tsai's Criterion (AICC)	13369.103569
Bozdogan's Criterion (CAIC)	13381.919417
Schwarz's Bayesian Criterion (BIC)	13379.919417

The information criteria are displayed in smaller-is-better form.

a. Dependent Variable: MathematicalHabitus.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	8.646	1802.311	<.001

a. Dependent Variable: MathematicalHabitus.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	51.082	1.203	8.646	42.454	<.001	48.343	53.821

a. Dependent Variable: MathematicalHabitus.

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Residual		184.858	6.444	28.685	<.001	172.649	197.931
Intercept [subject = SchoolID]	Variance	13.252	6.958	1.905	.057	4.736	37.086

a. Dependent Variable: MathematicalHabitus.

Empirical Best Linear Unbiased Predictions[a]

School ID	Parameter	Prediction	Std. Error	df	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	Intercept	1.155	1.409	15.392	.425	-1.841	4.152
2.00	Intercept	.419	1.453	17.013	.776	-2.646	3.484
3.00	Intercept	2.857	1.489	18.358	.071	-.266	5.980
4.00	Intercept	2.225	1.432	16.231	.139	-.806	5.257
5.00	Intercept	-5.546	1.631	23.558	.002	-8.916	-2.175
6.00	Intercept	4.921	1.508	19.071	.004	1.766	8.076
7.00	Intercept	-5.015	1.692	25.553	.006	-8.497	-1.534
8.00	Intercept	.834	1.493	18.514	.583	-2.296	3.964
9.00	Intercept	-3.386	1.555	20.819	.041	-6.621	-.151
10.00	Intercept	1.537	1.597	22.352	.346	-1.772	4.846

a. Dependent Variable: MathematicalHabitus

Model 2

Information Criteria[a]

-2 Restricted Log Likelihood	1335.9426737
Akaike's Information Criterion (AIC)	1339.9426737
Hurvich and Tsai's Criterion (AICC)	1340.0149628
Bozdogan's Criterion (CAIC)	1348.2024711
Schwarz's Bayesian Criterion (BIC)	1346.2024711

The information criteria are displayed in smaller-is-better form.

a. Dependent Variable: MathematicalHabitus.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	72.374	139.222	<.001
Pupil_GenderRECODE	1	129.976	9.317	.003
Pupileth1_1	1	91.376	.517	.474
Pupileth1_2	1	66.377	3.152	.080
Pupil_FSM	1	169	.418	.519
Pupil_EAL	1	169.000	3.559	.061
TeacherGender_RECODE	1	151.498	.091	.764
TeacherID	1	20.804	3.130	.092
Peer_Influence	1	163.822	4.961	.027
ParentPositiveAttitudes	1	166.050	1.855	.175

a. Dependent Variable: MathematicalHabitus.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	52.973	5.824	68.274	9.096	<.001	41.352	64.593
[Pupil_GenderRECODE=1.00]	5.342	1.750	129.976	3.052	.003	1.879	8.804
[Pupil_GenderRECODE=2.00]	0[b]	0	.	.	.	.	.
[Pupileth1_1=.00]	2.037	2.834	91.376	.719	.474	-3.591	7.665
[Pupileth1_1=1.00]	0[b]	0	.	.	.	.	.
[Pupileth1_2=.00]	-5.540	3.120	66.377	-1.775	.080	-11.768	.689
[Pupileth1_2=1.00]	0[b]	0	.	.	.	.	.
[Pupil_FSM=1.00]	1.242	1.921	169	.647	.519	-2.550	5.034
[Pupil_FSM=2.00]	0[b]	0	.	.	.	.	.
[Pupil_EAL=1.00]	-3.812	2.020	169.000	-1.887	.061	-7.800	.177
[Pupil_EAL=2.00]	0[b]	0	.	.	.	.	.
[TeacherGender_RECODE=1.00]	-.549	1.822	151.498	-.301	.764	-4.148	3.050
[TeacherGender_RECODE=2.00]	0[b]	0	.	.	.	.	.
TeacherID	-.069	.039	20.804	-1.769	.092	-.149	.012
Peer_Influence	.808	.363	163.822	2.227	.027	.092	1.524
ParentPositiveAttitudes	.253	.185	166.050	1.362	.175	-.114	.619

a. Dependent Variable: MathematicalHabitus.

b. This parameter is set to zero because it is redundant.

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Residual		113.712	12.702	8.953	<.001	91.354	141.542
Intercept [subject = SchoolID]	Variance	4.908	6.908	.711	.477	.311	77.417

a. Dependent Variable: MathematicalHabitus.

Empirical Best Linear Unbiased Predictions[a]

School ID	Parameter	Prediction	Std. Error	df	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1.00	Intercept	-.902	1.822	2.103	.668	-8.385	6.582
2.00	Intercept	-.806	1.836	1.959	.704	-8.867	7.254
3.00	Intercept	1.640	1.983	1.548	.516	-9.789	13.069
4.00	Intercept	2.448	1.834	2.022	.312	-5.360	10.256
5.00	Intercept	-1.922	1.725	2.491	.361	-8.104	4.261
6.00	Intercept	.269	1.770	2.228	.892	-6.647	7.184
7.00	Intercept	.165	1.849	2.008	.937	-7.759	8.089
8.00	Intercept	-.546	1.777	2.169	.786	-7.648	6.556
9.00	Intercept	-.634	1.963	1.603	.784	-11.433	10.165
10.00	Intercept	.287	1.961	1.601	.900	-10.522	11.096

a. Dependent Variable: MathematicalHabitus

Model 3

Information Criteria[a]

-2 Restricted Log Likelihood	1346.5074615
Akaike's Information Criterion (AIC)	1354.5074615
Hurvich and Tsai's Criterion (AICC)	1354.7513639
Bozdogan's Criterion (CAIC)	1371.0270564
Schwarz's Bayesian Criterion (BIC)	1367.0270564

The information criteria are displayed in smaller-is-better form.

a. Dependent Variable: MathematicalHabitus.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	169	18.522	<.001
Pupil_GenderRECODE	1	169	10.281	.002
Pupileth1_2	1	169	13.218	<.001
Pupileth1_3	1	169	.015	.903
Pupil_FSM	1	169	.428	.514
Pupil_EAL	1	169	5.101	.025
TeacherGender_RECODE	1	169	.140	.709
TeacherID	1	169	.434	.511
Peer_Influence	1	169	4.209	.042
ParentPositiveAttitudes	1	169	1.017	.315

a. Dependent Variable: MathematicalHabitus.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	61.472	13.839	169	4.442	<.001	34.151	88.792
[Pupil_GenderRECODE=1.00]	5.753	1.794	169	3.206	.002	2.211	9.295
[Pupil_GenderRECODE=2.00]	0[b]	0	.	.	.	.	.
[Pupileth1_2=.00]	-9.583	2.636	169	-3.636	<.001	-14.786	-4.380
[Pupileth1_2=1.00]	0[b]	0	.	.	.	.	.
[Pupileth1_3=.00]	-.361	2.954	169	-.122	.903	-6.192	5.471
[Pupileth1_3=1.00]	0[b]	0	.	.	.	.	.
[Pupil_FSM=1.00]	1.261	1.927	169	.654	.514	-2.544	5.065
[Pupil_FSM=2.00]	0[b]	0	.	.	.	.	.
[Pupil_EAL=1.00]	-4.587	2.031	169	-2.259	.025	-8.596	-.578
[Pupil_EAL=2.00]	0[b]	0	.	.	.	.	.
[TeacherGender_RECODE=1.00]	-.706	1.889	169	-.374	.709	-4.435	3.023
[TeacherGender_RECODE=2.00]	0[b]	0	.	.	.	.	.
TeacherID	-.129	.196	169	-.659	.511	-.516	.258
Peer_Influence	.741	.361	169	2.052	.042	.028	1.454
ParentPositiveAttitudes	.187	.186	169	1.009	.315	-.179	.554

a. Dependent Variable: MathematicalHabitus.

b. This parameter is set to zero because it is redundant.

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Residual		111.215	12.270	9.064	<.001	89.588	138.063
Intercept + TeacherID [subject = SchoolID]	UN (1,1)	1387.836[b]	.000	.	.	.	.
	UN (2,1)	-21.357[b]	.000	.	.	.	.
	UN (2,2)	.000[b]	.000	.	.	.	.

a. Dependent Variable: MathematicalHabitus.

b. This covariance parameter is redundant. The test statistic and confidence interval cannot be computed.

Empirical Best Linear Unbiased Predictions[a]

School ID	Parameter	Prediction	Std. Error	df	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1.00	Intercept	-7.743	13.155	169.000	.557	-33.712	18.225
	TeacherID	2.710	5.129	169.000	.598	-7.415	12.835
2.00	Intercept	-5.129	13.431	169.000	.703	-31.644	21.385
	TeacherID	.228	.341	169.000	.506	-.446	.901
3.00	Intercept	15.436	15.689	169.000	.327	-15.536	46.408
	TeacherID	-.239	.492	169.000	.627	-1.210	.731
4.00	Intercept	19.425	15.488	169.000	.212	-11.150	49.999
	TeacherID	.182	.873	169.000	.835	-1.542	1.905
5.00	Intercept	-16.798	18.192	169.000	.357	-52.710	19.114
	TeacherID	3.251	1.189	169.000	.007	.904	5.598
6.00	Intercept	9.926	33.108	169.000	.765	-55.433	75.285
	TeacherID	-3.427	8.304	169.000	.680	-19.820	12.966
7.00	Intercept	-8.820	25.338	169.000	.728	-58.841	41.200
	TeacherID	-1.719	1.944	169.000	.378	-5.555	2.118
8.00	Intercept	-.123	15.198	169.000	.994	-30.126	29.880
	TeacherID	.083	.770	169.000	.914	-1.436	1.603
9.00	Intercept	-.047	14.937	169.000	.997	-29.534	29.440
	TeacherID	.093	.452	169.000	.836	-.799	.986
10.00	Intercept	-6.125	13.999	169.000	.662	-33.761	21.511
	TeacherID	-1.162	.350	169.000	.001	-1.852	-.471

a. Dependent Variable: MathematicalHabitus