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The impact of multilingualism and socio-economic status on academic performance: evidence from the SCAMP and the national pupil databases

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ABSTRACT

This study examines the impact of multilingualism and socioeconomic status on academic performance within the UK, utilising data from 3,213 pupils from the National Pupil Database who also took part in the Study of Cognition, Adolescents and Mobile Phones (SCAMP). We employed multilevel modelling to analyse the relationship between language experience, socioeconomic status and Key-Stage 2 (KS2∼11 years) and Key-Stage 4 (KS4∼16 years) performance in English, Mathematics and Science. Findings reveal that multilingual learners initially face academic challenges at KS2, particularly in English and Science, but achieve comparable results with monolingual peers by KS4, overcoming early setbacks. Notably, simultaneous multilinguals not only catch up but excel beyond their monolingual counterparts by KS4, demonstrating the significant long-term academic benefits of early multilingual exposure and /or its associated cultural factors. Further analysis indicates that multilingual group membership mitigated the adverse effects of low socioeconomic status, with pupils from these backgrounds making substantial academic strides between KS2 and KS4 compared to monolingual peers. This challenges prevalent misconceptions about multilingualism in education. These findings underscore the need for educational policies that harness linguistic diversity to foster academic equity and success, emphasising the crucial role of language experience and socioeconomic factors in shaping educational outcomes.

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Introduction

The intricate link between language experience and educational outcomes continues to captivate the academic discourse in psycholinguistics and educational research. The historic debate on bilingualism and multilingualism—terms used interchangeably in this context—has shifted dramatically from early twentieth-century concerns over supposed cognitive impairments in multilingual children (e.g. Saer 1923) to a contemporary understanding that multilingual upbringing holds no inherent cognitive harm (e.g. Filippi, D'Souza, and Bright 2018, Filippi, Ceccolini, and Bright 2021; Filippi, Ceccolini, Periche-Tomas, and Bright 2020; Filippi, Ceccolini, Periche-Tomas, Papageorgiou, et al. 2020;

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Filippi, Periche Tomas, et al. 2020; Filippi et al. 2015, 2022), even in children with developmental conditions (e.g. Dai et al. 2018; Drysdale, van der Meer, and Kagohara 2015).

Extensive research conducted by Bialystok and others, has shown a positive impact of bilingualism on metalinguistic awareness and, particularly, executive processes (see Bialystok 2017 for a review). The phrase 'bilingual advantage' was coined to describe the purported superior performance in certain non-verbal tasks assessing executive function components like inhibitory control, task switching, and working memory (refer to Miyake et al. 2000, for a comprehensive executive function framework and the work of Paap 2022, for a critical review of the bilingual advantage hypothesis).

While acknowledging the rich body of research suggesting bilingualism may (or may not) enhance certain cognitive abilities, this manuscript deliberately adopts a more nuanced perspective. We concentrate on the practical implications of multilingualism for educational attainment, sidestepping the binary of 'advantage' versus 'disadvantage' in favour of examining how multilingual experience in early stages of life can have an impact on school performance.

Despite potential positive effects of multilingual acquisition, both theoretically and practically, empirical evidence on its impact on educational achievement in representative samples is inconclusive. Some studies report that bilingual children surpass monolinguals academically (Barac and Bialystok 2012), while others find minimal or no academic impact (Han 2012). Anecdotally, concerns persist among parents and educators that multilingualism could hinder children's linguistic and cognitive development or burden classroom dynamics. These misconceptions have been broadly refuted in scientific literature (e.g. Filippi and Bright 2023) and educational statistical reports (Hutchinson 2018).

Moreover, the distinction between different linguistic experiences has been inadequately investigated. Specifically, in the context of bilingual research, the label *simultaneous multilinguals* refers to individuals who have been exposed to two languages from birth. This exposure means that both languages are acquired simultaneously, allowing the individual to develop native-like proficiency in both. Unlike *sequential multilinguals,* also described as *multilingual learners*, who learn a second language after establishing a foundation in their first language, simultaneous multilinguals acquire both languages concurrently, often using them interchangeably from the outset of language acquisition.

Therefore, this current study addresses these gaps by examining the relationship between language experience and school performance using actual exam results from the National Pupil Database (NPD) and linguistic experience from the Study of Cognition, Adolescents and Mobile Phones (SCAMP) database.

We categorised participants based on their responses to the SCAMP questionnaire, cross-refed with the NPD, indicating whether English was their first language, with three possible answers: (1) Yes, (2) No, and (3) English learned at the same time as another language. Three linguistic groups were therefore obtained: simultaneous multilingual (SM), multilingual learners (ML), and English monolinguals (EM). All pupils, followed longitudinally in the age range 11–12 to 15–16 years, offered a detailed examination of multilingualism's influence throughout development and contributing to the discourse on bilingual education and academic achievement.

Recent studies and contextual framework

Studies examining the long-term academic performance of bilingual children using actual exam results are scarce, with most research relying on teacher assessments or standardised tests used for research purposes (Thomas and Collier 2002). A recent study by Hessel and Strand (2021) focused on the UK context and examined how multilingual students aged 5–16 years perform in standardised tests compared to their monolingual peers. The study found no significant differences in performance, challenging common perceptions about the disadvantages of multilingualism in

education mentioned above. The authors suggest that multilingualism itself may confer hidden cognitive advantages that are not directly measured by traditional academic assessments.

Dai et al. (2023) investigated the effects of multilingual exposure on academic performance across various countries. They found that students in the multilingual learner group often performed better in cognitive flexibility tests, which correlated positively with academic achievement in multilingual settings. This study emphasises the cognitive benefits that extend into academic advantages, suggesting that the educational systems might need to adjust teaching strategies to harness these benefits effectively.

Research conducted in Canada by Kim et al. (2020) explored how changes in home language use impact English literacy achievement over time by analysing longitudinal data. They discovered that students who maintained consistent use of their home language alongside English demonstrated better literacy outcomes. This study supports the notion that sustained bilingualism contributes positively to academic performance, advocating for educational policies that promote maintaining the home language in the curriculum. In Australia, O'Connor et al. (2018) investigated the impact of early multilingual education on later academic success. Findings indicate that children who participate in multilingual education programs from a young age show improved academic performance in later years, particularly in areas requiring complex cognitive skills. The research supports implementing multilingual education programs that integrate multiple languages seamlessly into the curriculum to enhance cognitive and academic outcomes.

Multilingualism, education and socio-economic status

Filippi et al. (2022) analysed a substantial dataset to explore the interaction between socio-economic status (high vs. low) and linguistic experience (monolingualism vs. multilingualism) on executive function development, using a matched sub-sample from the SCAMP dataset. The sample included 517 monolingual and 329 multilingual secondary school pupils in London. They underwent executive function assessments at two developmental stages, at ages 11 and 15.

Monolingual and multilingual groups were carefully matched on socioeconomic status metrics and then a range of cognitive abilities were compared. The findings suggest that multilingualism has a generally positive effect on working memory, visuo-spatial processing, and non-verbal reasoning with small to medium effect sizes. Specifically, the proportion of variance in these cognitive functions explained by bilingualism ranged from 0.5% to 2.0%. Additionally, there were marked improvements in working memory for pupils from lower socio-economic backgrounds over the time period studied.

Pupils from underprivileged background were also studies by Winsler et al. (2023), who examined the long-term academic outcomes of multilingual learners in Miami (USA), focusing on the impact of early English proficiency. Tracking a large cohort of low-income multilingual pupils from preschool through 5th grade, the study found that achieving English proficiency earlier, particularly before 2nd grade, significantly predicted better academic performance in 5th grade. This relationship held true across various metrics, including Grade Point Average (GPA), standardised test scores in reading and math, and grade retention, even after controlling for factors such as gender, ethnicity, poverty, and school readiness skills.

These studies, and others that are not included for brevity (e.g. Goodrich, Thayer, and Leiva 2021; Oh, Bertone, and Luk 2023), collectively underscore the subtle relationship between multilingualism and academic performance, highlighting the potential for educational gains through appropriately tailored instructional strategies and policies that recognise the diverse linguistic backgrounds of students.

However, researchers investigating educational outcomes cannot isolate the effect of multilingualism via experimental manipulation and random allocation to condition. Studies are necessarily observational. This means that studying the full spectrum of multilingualism's impact is a complicated endeavour, fraught with the challenge of accounting for several confounding factors,

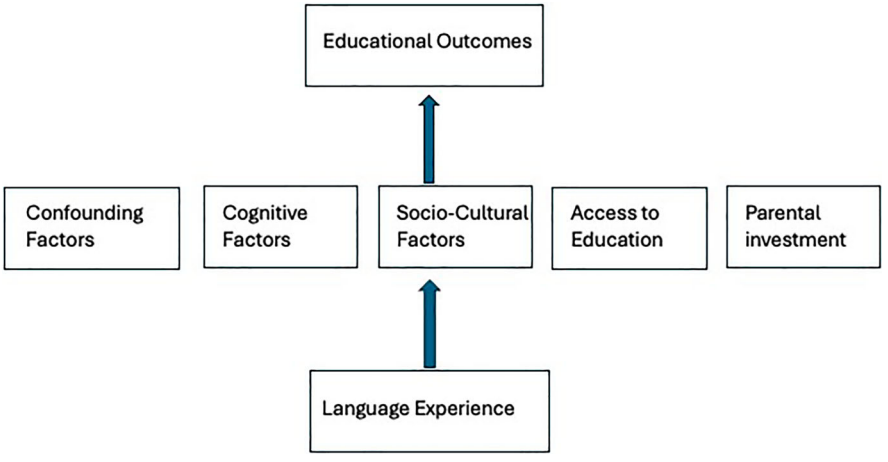

Figure 1. Factors influencing educational outcomes in relation to language experience.

cognitive factors, socio-cultural factors (e.g. socio-economic status – SES), access to education and parental investment in their children's education (see Figure 1). This complexity necessitates a cautious interpretation of the relationship between multilingual acquisition and academic performance.

Our study focuses on the direct examination of school performance, drawing upon data from the National Pupil Database and the SCAMP database. We compare English monolingual (EM), multilingual learners (ML), and native multilingual (NM) pupils, aiming to elucidate the subtle influences of language experiences and socio-economic status over the course of academic development. We address two key questions:

1. What is the impact of language experience on school attainment in the three key subjects (i.e. English, Maths and Science) throughout development?
2. What is the link between multilingualism, socio-economic status and school performance at SAT (Key stage 2) and GCSE (Key stage 4)?

Given the complexity of factors influencing educational outcomes, including cognitive, socio-cultural, and economic elements, the current study aims to provide further evidence of how multilingual experience shapes educational trajectories by focussing on educational outcomes. Forthcoming analyses will examine cognitive data from the SCAMP database to determine whether cognitive abilities mediate the relationship between first language status and school attainment (Perry et al., in preparation). This future direction is essential to paint a comprehensive picture of bilingualism's role in cognitive and educational development.

Methodology

Participants

A total of 3,213 participants (51% females) were extracted from the SCAMP dataset, with the following criteria: (1) only pupils with complete exam results for both SATs and GCSEs, (2) only pupils with well-reported linguistic backgrounds, that is, consistent data regarding their first and additional language, as self-reported in the SCAMP study questionnaire. The pupils in this study were aged between 11 and 16 years, allowing for analysis of the whole sample size with both timepoints in Key Stage 2 (KS2) and Key Stage 4 (KS4).

The pupils attended 25 different state schools in London, UK. All schools were anonymously coded with an identification number (see Appendix 1).

Linguistic group selection and allocation criteria

The SCAMP dataset contains linguistic and demographic information collected through questionnaires. All participants indicated whether English was their first language with three possible answers: (1) Yes, (2) No, and (3) English learned at the same time as another language. These groups are henceforth referred to as: (1) English monolinguals ($N = 1{,}648$), (2) multilingual learners ($N = 735$) and (3), simultaneous multilinguals ($N = 830$).

Languages

The dataset presents a rich tapestry of linguistic diversity, encompassing a total of 65 distinct languages, other than English, which illustrates the wide-ranging cultural and geographical backgrounds of the study's participants. The languages are broadly categorised across five continents, reflecting a significant representation of linguistic families and groups (see Figure 2 and Table 1).

Asia emerges as the most linguistically diverse continent within this dataset, showcasing languages such as Tamil, Persian/Farsi, Arabic, and Japanese, among others. Europe follows, with languages including Polish, German, Italian, and Russian. The dataset also captures languages from Africa (e.g. Somali, Swahili/Kiswahili, Yoruba), North and South America, such as French (including Caribbean Creole French) and Portuguese, respectively.

Exam description

In the UK educational system, students typically undertake two significant sets of examinations: the SATs (Standard Assessment Tests) and the GCSEs (General Certificate of Secondary Education). SATs are administered at the end of Key Stage 2 (KS2) when pupils are aged 10–11, primarily assessing

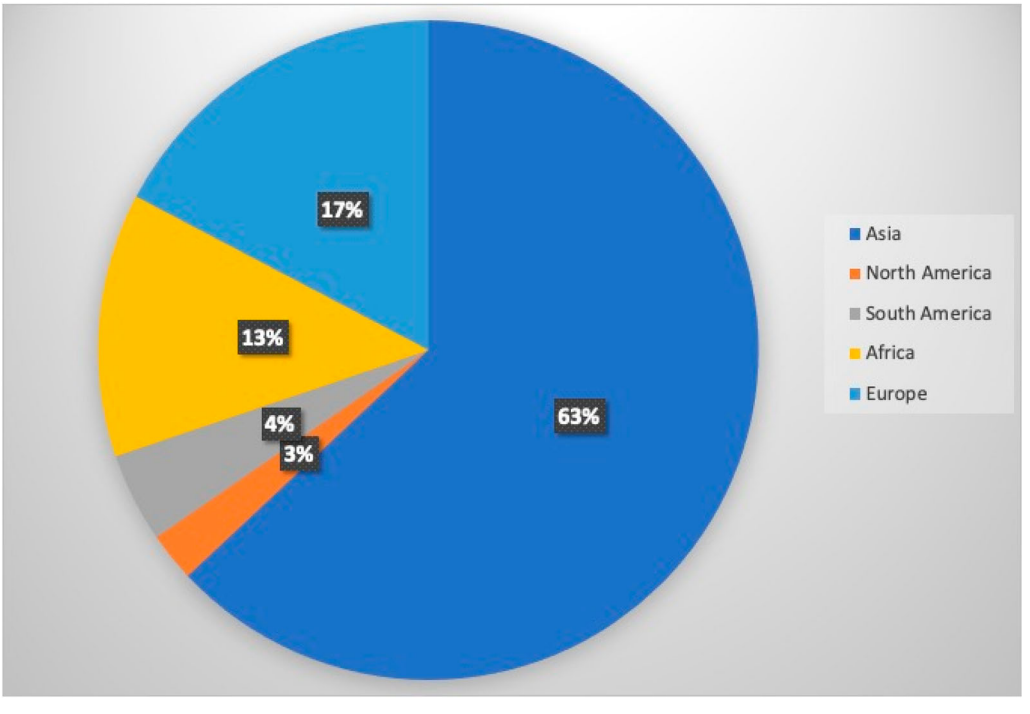

Figure 2. Percentage of languages by continent represented in this study (excluding English).

Table 1. Languages represented in this study by Continent and in alphabetical order.

Continent	Languages
Africa	Akan/Twi-Fante, Berber/Tamazight, Kanuri, Lingala, Somali, Swahili/Kiswahili, Wolof, Yoruba
Asia	Amharic, Arabic, Armenian, Bengali, Burmese/Myanma, Chinese, Gujarati, Hausa, Hebrew, Hindi, Japanese, Kurdish, Malay/Indonesian, Malayalam, Marathi, Nepali, Pashto/Pakhto, Persian/Farsi, Rajasthani/Marwari, Sindhi, Sinhala, Tagalog/Filipino, Tamil, Telugu, Thai, Tigrinya, Turkish, Urdu, Vietnamese
Europe	Albanian/Shqip, Bulgarian, Danish, Dutch/Flemish, French, German, Greek, Hungarian, Italian, Latvian, Polish, Romanian, Romany/English Romanes, Russian, Serbian/Croatian/Bosnian, Slovak, Spanish, Swedish
North America	Caribbean Creole French, French
South America	Portuguese, Spanish

their proficiency in English, mathematics, and science. These tests aim to measure the effectiveness of primary education and determine the students' academic progress.

GCSEs, on the other hand, are taken by students aged 15–16 at the end of Key Stage 4 (KS4). These examinations cover a wide range of subjects, providing a broad spectrum of academic and vocational education. GCSEs serve as a foundational qualification, influencing further educational paths and career choices. Success in these examinations is crucial for progression to A-levels, vocational courses, or apprenticeships. The grading system for GCSEs traditionally ranged from A* to G, but has recently transitioned to a numerical format, with grades 9–1, where 9 is the highest.

In this study, the results from SATs and GCSEs exams were merged to the selected sample through the participants' Universally Unique identifier (UUID).

The results focussed on three key subjects: English, Maths and Science. The SATs exam had four variables, English writing, English reading and Maths with scores ranging from 1 to 6[1], where 4 is the expected standard. Science is teacher assessed and measured on a scale of 2-6. The GCSEs exam had three variables, English, Maths and Science, with scores ranging from 1 to 9 where 4 is a standard pass.

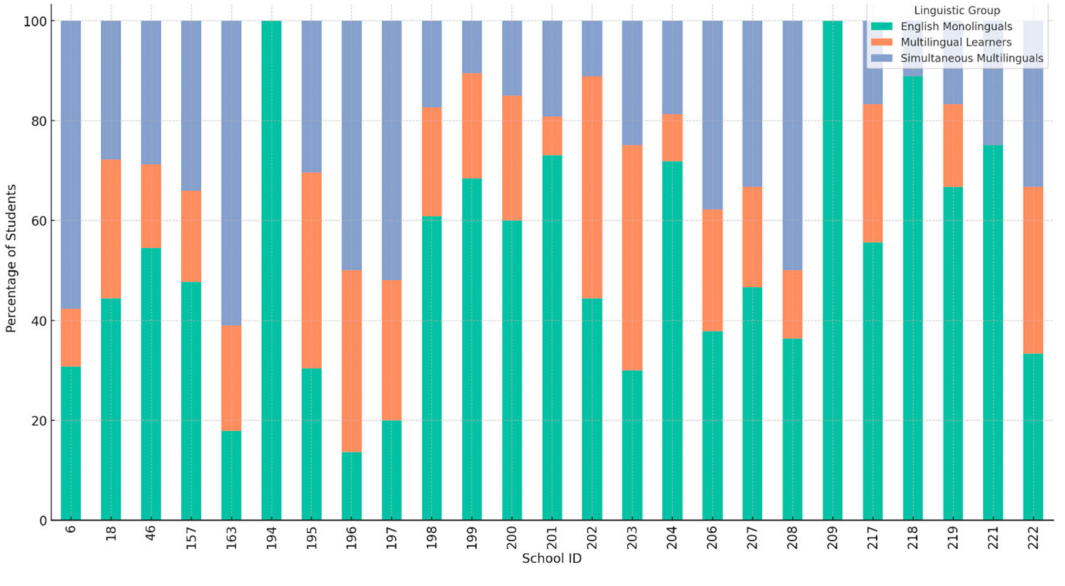

Figure 3. The bar chart displays the percentage distribution of students receiving free school meals within the three linguistic groups, segmented by each school. Each segment within a bar represents the percentage of free school meals students from a specific linguistic group relative to the total number of free school meals students in that school.

Demographic background

The age across all groups when they took the exam was statistically comparable at both SAT (KS2) (M = 10.7 years old, SD = 0.43) and GCSE (KS4) (M = 15.8 years old, SD = 0.42).

At KS2, 615 pupils were on Free School Meals (FSM). 126 were MLs, 207 were SMs and 282 EM. At KS 4, they were 260 (44 MLs, 88 NMs and 128 EMs). Figure 3 illustrates the distribution of language categories among pupils with Free School Meals (FSM) in the different schools.

Free school meals are programmes designed to provide nutritious meals at no cost to children attending school. Students of English nationality between the ages of 5 and 16 qualify for free school meals if their families have a very low income. The eligibility threshold for families receiving Child Tax Credits has been set at an annual pre-tax household income of £16,190 since 2010. Additionally, certain groups of students, such as those whose families cannot access public funds —including children of parents on work or student visas and asylum seekers supported under Part VI of the Immigration and Asylum Act 1999—are also eligible for free school meals. In this study, FSM is used as a proxy for socio-economic status.

The scamp database and the national pupil database

The data for this study comes from a large cohort study known as the Study of Cognition, Adolescents and Mobile Phones (SCAMP), which is led by Imperial College, London, UK. The current study involves the identification of linguistic groups by assessing the linguistic experience data collected from the SCAMP questionnaires and by comparing these groups' school attainment taken from the NPD database.

The National Pupil Database in the UK is a comprehensive resource that plays a critical role in educational research and policy-making. It provides a rich set of data that can be used to understand educational outcomes and inform strategies for improving the educational system.

Data from both databases were merged through the pupil's universal unique identifier (UUID).

Data analysis approach

We used a multilevel modelling approach. The rationale for our chosen analytical approach stems from the theoretical foundation of our research. Specifically, we aimed to investigate whether multilingualism predicts academic performance at a specific age, while controlling for prior performance.

Additionally, utilising a multilevel modelling approach allowed us to analyse the complex interactions between individual student performance and broader socio-economic factors. This statistical method is particularly effective in handling the nested structure of educational data, where students are grouped within schools, allowing for more accurate estimates of both individual and group-level effects. By applying this approach, we could explore the effects of multilingualism across different socioeconomic contexts, providing robust insights into the disparities and potentials within educational settings.

We focused on on two key stages: SAT (KS2) and GCSE (KS4). In all iterations of our multilevel models, the random effect attributable to the *School_ID* variable—representing the nesting of pupils' results within 25 distinct educational institutions—consistently emerged as a statistically significant factor, thereby reinforcing the appropriateness of a multilevel analytical framework for our study. Baseline-corrected results for GCSE were also analysed, allowing us to measure academic growth and the raw academic performance of the different groups across development. The dataset comprised students categorised into three language groups: *simultaneous multilinguals*, *multilingual learners*, and *English monolinguals*.

We analysed the students' performance in these groups by comparing their mean scores, overall and by subject (i.e. English, Maths and Science), across different schools, included *Free School Meals* (FSM) as a proxy for socio-economic status.

The analysis was structured for pairwise comparisons among the language groups for the dependent variable (i.e. school attainment at SAT and GCSE). Three 'dummy' variables were created for each group and the English monolinguals were used as the reference group.

We employed Linear Mixed Effects models to accommodate the nested structure of the data, with students grouped within school clusters. The fixed effects in the model were language experience, school multilanguage clusters and socio-economic status, while the random effects were the intercepts for schools (*School ID*), acknowledging that schools inherently differed in their overall performance levels.

The models provided estimates of the coefficients for the language group comparisons, indicating the mean difference in performance between the groups, along with standard errors, *p*-values, and 95% confidence intervals for these estimates. These results offered insights into the significance and magnitude of the differences in school attainment between simultaneous multilinguals, multilingual learners, and English monolinguals at two crucial stages of their education.

Results

Initially, descriptive statistics were utilised to ascertain the distribution of pupils across various language groups (multilingual learners, simultaneous multilinguals, and English monolinguals) within different schools (see Appendix 1, Table A1). In exploring the relationship between language background and socioeconomic status, as inferred from eligibility for free school meals, we conducted a Chi-squared test of independence. Although the test yielded a significant result, $\chi^2(2, N = 3287) = 24.31$, $p < .001$, it is important to note that the distribution of language backgrounds in the sample was not uniform: English monolinguals were overrepresented in the dataset. Despite this, the test highlights a significant discrepancy between the observed and expected counts of pupils eligible for free school meals across the language backgrounds, suggesting an association between language background and socioeconomic status. Significantly, our findings indicate that pupils with multilingual backgrounds tend to outperform their monolingual peers academically, a pattern that underscores the potential benefits of multilingualism in educational contexts, and deserves further investigation to understand the implications fully.

The results for English reading and writing at SATs (KS2) were combined to yield a single mean score for the English subject, akin to the approach used for GCSEs (KS4). Mean scores at GCSE are typically higher, reflecting the exam's grade scale of 1-9, whereas the archived SATs data uses a 1–6 scale. Mean scores and standard errors are illustrated with all school subjects combined for SATs (Figure 4) and GCSEs results (Figure 5) for both Free School Meals and non-Free School Meals pupils. The complete scores overall and by school subject are reported in Appendix 2, Tables A2 and A3.

For the statistical analyses, in order to have two comparable sets of data, SATs and GCSEs scores were scaled to obtain a 0–10 data point; specifically, SATs scores were multiplied by 10/6 and GCSEs scores were multiplied by 10/9.

In the following sections, we present the results of our analyses, which were structured to explore the impact of linguistic and socioeconomic factors on academic performance at two critical educational stages, SATs and GCSEs. The analyses begin with the SAT results, followed by baseline-corrected and non-baseline-corrected results for GCSE. The complete list of statistical results for all models is reported in Appendix 3, Table A4.

SATs – key stage 2 (KS2) ~ 11 years

First, the overall performance at SAT was analysed for multilingual learners and simultaneous multilinguals in comparison with the English monolingual group, which was always used as a reference. Multilevel modelling revealed that multilingual learners scored significantly lower than the monolingual group ($B = -0.53$, $SE = 0.051$, $t(3060.906) = -10.335$, $p < .001$, $\beta = -.214$), indicating a small

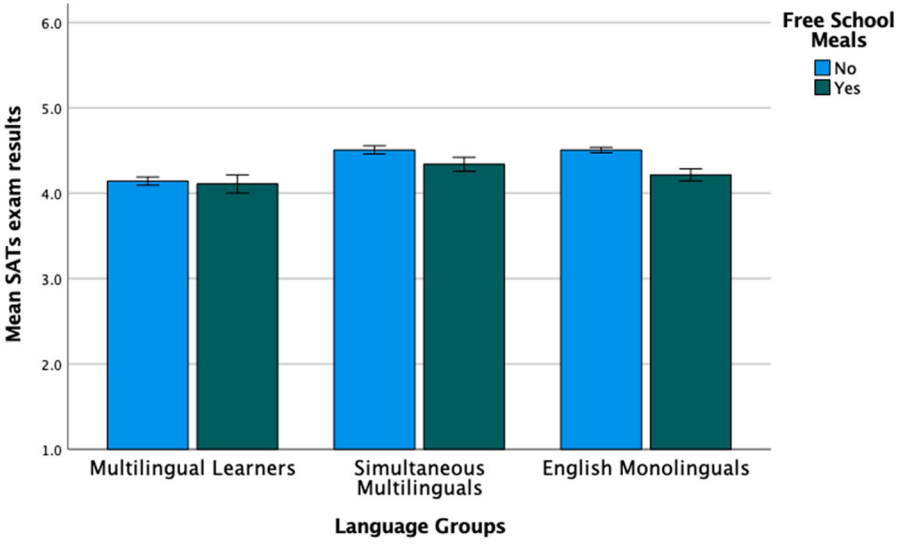

Figure 4. SATs' (KS2) mean results and standard errors for all school subjects (English, Maths and Science) combined. The darker bars indicate pupils with Free School Meals, which is used as a proxy of socio-economic status. Scale numbers for SAT are from 1 to 6.

negative effect. Conversely, simultaneous multilinguals' scores did not significantly differ from those of English monolingual students ($B = 0.039$, $SE = 0.051$, $t(3045.721) = 0.763$, $p = .446$, $\beta = .016$).

Free school meals at SAT

The main effect of free school meal status was significant and negative at SAT ($B = -0.49$, $SE = 0.066$, $t(3203.322) = -7.405$, $p < .001$, $\beta = -.185$), indicating that, on average, students who are eligible for

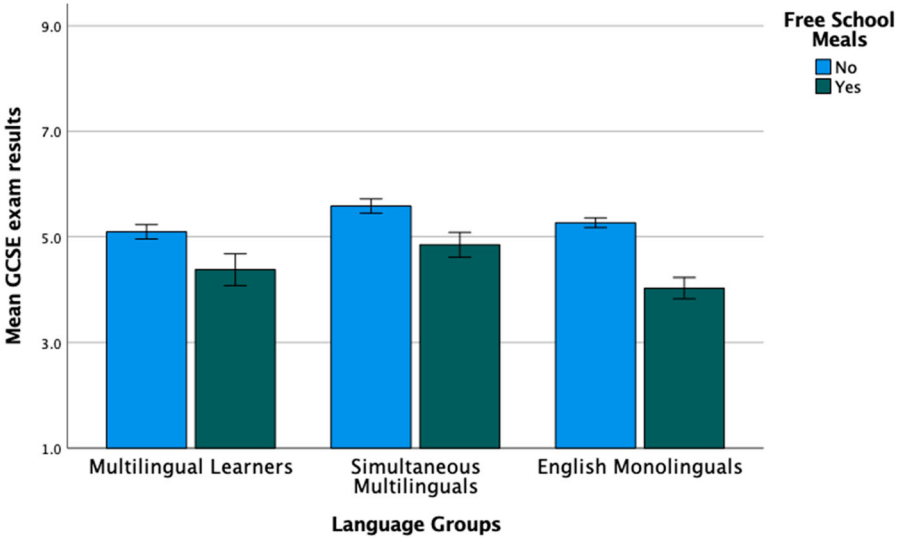

Figure 5. GCSEs' (KS4) mean results and standard errors for all school subjects (English, Maths and Science) combined. The darker bars indicate pupils with Free School Meals, which is used as a proxy of socio-economic status. Scale numbers for GCSE are from 1 to 9.

free school meals perform worse compared to their peers. The effect size is moderate, emphasizing a modest but clear disadvantage associated with lower socioeconomic status.

However, the interaction between multilingual learners and free school meal status was significant ($B = 0.387$, $SE = 0.117$, $t(3197.345) = 3.306$, $p = .001$, $\beta = .185$). This interaction suggests that the negative effects of socioeconomic status on KS2 are less severe for multilingual learners. Essentially, the adverse effects of socioeconomic status are weaker among multilingual learners compared to English monolinguals, who do not exhibit the same level of resilience or mitigated impact.

The interaction effect was not observed for simultaneous multilinguals ($B = 0.189$, $SE = 0.103$, $t(3202.141) = 1.829$, $p = .067$, $\beta = .089$). This outcome implies that for simultaneous multilinguals, the presence of free school meal status does not significantly modify their SAT performance either positively or negatively compared to those not on free school meals.

In order to understand the nuances of academic performance, separate multilevel analyses were conducted for English, Maths, and Science at SAT. These analyses aimed to discern the relative impact of being a multilingual learner or a simultaneous multilingual compared to English monolingual peers across these key subjects. Below are the findings from each subject-specific analysis, inclusive of the calculated effect sizes:

English: Multilevel modelling for English SAT scaled scores indicated that multilingual learners performed significantly lower than monolingual peers ($B = -0.57$, $SE = 0.049$, $t(3049.287) = -11.519$, $p < .001$, $\beta = -.218$), which is a small effect size. Simultaneous multilinguals showed no significant difference in performance compared to monolingual students ($B = -0.001$, $SE = 0.048$, $t(2967.523) = -0.016$, $p = .987$, $\beta \approx 0$).

Maths: For Maths SAT scaled scores, multilingual learners scored lower than English monolinguals ($B = -0.22$, $SE = 0.064$, $t(2879.663) = -3.480$, $p = .001$, $\beta = -.068$), a small effect size. Conversely, simultaneous multilinguals significantly outperformed monolingual students ($B = 0.25$, $SE = 0.062$, $t(2734.071) = 4.011$, $p < .001$, $\beta = .079$), also a small effect size.

Science: In Science KS2 scaled scores, multilingual learners again scored lower than monolinguals ($B = -0.44$, $SE = 0.051$, $t(3037.935) = -8.715$, $p < .001$, $\beta = -.167$), a small effect size. Simultaneous multilinguals did not differ significantly from their monolingual counterparts ($B = 0.01$, $SE = 0.049$, $(2951.350) = 0.232$, $p = .817$, $\beta = .005$).

The results highlight that multilingual learners may face relative challenges at SAT in all key subjects (i.e. English, Maths and Science), although the effect size is small. However, these challenges appear to be less pronounced in Maths. The small positive effect size for simultaneous multilinguals in Maths suggests a potential area of strength for these students.

GCSE results – key stage 4 (KS4) ~ 16 years

The multilevel analysis was repeated for GCSE scaled scores. The analysis showed no significant difference in the performance of multilingual learners compared to English monolingual students ($B = -0.024$, $SE = 0.096$, $(3167.985) = -0.249$, $p = .804$, $\beta \approx 0$). The result shows that the academic gap observed at SAT was no longer present.

The simultaneous multilinguals group demonstrated a significantly better performance than the monolingual group ($B = 0.443$, $SE = 0.095$, $t(3162.260) = 4.638$, $p < .001$, $\beta = .255$). The effect size suggests a moderate positive impact of simultaneous multilingualism on GCSE performance.

Free school meals at GCSE

Even at GCSE there was a significant negative impact of eligibility for free school meals on overall results ($B = -1.197$, $SE = 0.123$, $t(3206.900) = -9.696$, $p < .001$, $\beta = -1.4391$), marking a considerable disadvantage for students from lower socioeconomic backgrounds. The effect size ($\beta = -1.439$) indicates a large adverse effect of free school meals status on GCSE outcomes.

However, the interaction between being a multilingual learner and free school meal status was not statistically significant ($B = 0.411$, $SE = 0.218$, $t(3193.613) = 1.881$, $p = .060$), with a small effect

size ($\beta = .176$). This suggests that the free school meal status does not significantly alter the GCSE performance of multilingual learners relative to their peers.

There was a significant interaction between simultaneous multilinguals and free school meals status ($B = 0.476$, $SE = 0.193$, $(3197.717) = 2.467$, $p = .014$). The effect size ($\beta = .098$) is small but statistically significant, suggesting that simultaneous multilinguals who are eligible for free school meals perform slightly better than expected given the overall negative influence of socioeconomic status. This indicates that multilingual acquisition since early stages of life may provide some resilience against the socioeconomic disadvantages impacting educational outcomes at GCSE.

Summary of results

In comparing the educational outcomes of multilingual learners and simultaneous multilinguals to English monolinguals at both SAT (Key Stage 2) and GCSE (Key Stage 4), our study revealed notable differences. At SAT, while multilingual learners showed a significant lag in performance compared to monolinguals, simultaneous multilinguals did not exhibit significant disparities.

However, at GCSE, simultaneous multilinguals outperformed English monolinguals significantly. Notably, multilingual learners reached similar outcomes to English monolinguals, a compelling result indicating their remarkable catch-up from SAT.

Eligibility for free school meals had a consistently detrimental impact on academic performance at both stages, with a larger effect size observed at GCSE, indicating a greater socioeconomic disadvantage at a later educational stage for all FSM pupils.

However, in the examination of interactions between FSM and multilingual experience, the effect sizes were smaller at SAT, where only multilingual learners showed a significant interaction. On the contrary, simultaneous multilinguals demonstrated a significant interaction at GCSE, again with small effect size.

These findings, illustrated in Figure 6, underscore the nuanced interplay between linguistic background, socioeconomic status, and academic achievement across different educational stages and suggest that a multilingual experience may reduce the negative impact of unprivileged background on academic performance.

Baseline-corrected GCSE results – key stage 4 (KS4) ~ 16 years

By using SAT results as a baseline, we adjusted GCSE outcomes to specifically measure academic growth. This analysis focuses on how students in each group have progressed academically from SAT to GCSE.

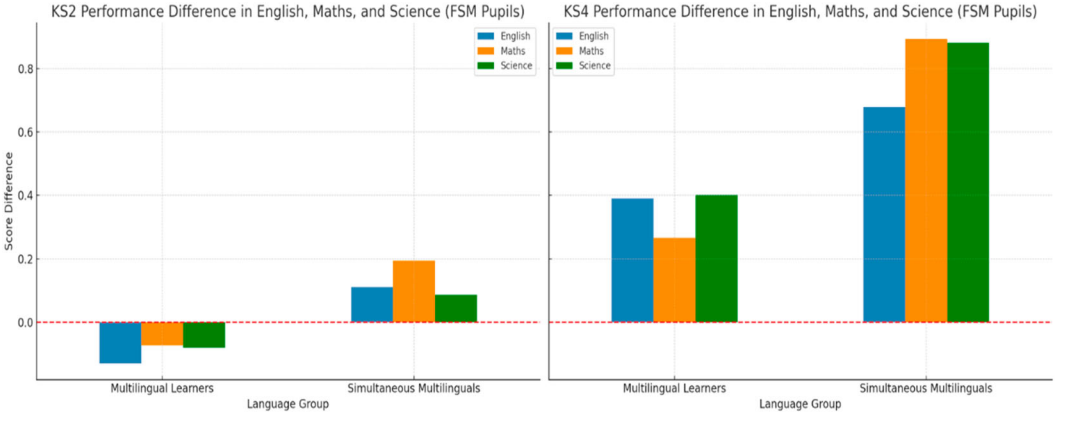

Figure 6. Performance in English, Maths and Science of multilingual learners and simultaneous multilingual FSM pupils at SAT (KS2) and GCSE (KS4) in comparison with their English monolingual counterparts, with value of zero.

The results indicated that baseline academic ability at KS2 was a significant predictor of subsequent academic achievement at GCSE, ($B = 1.336$, (3201.884) = 56.999, $p < .001$), with a large effect size ($\beta = .709$). This demonstrates a strong and significant impact of early academic ability on later achievement.

In terms of language experience, both multilingual learners and simultaneous bilinguals demonstrated significantly higher attainment at GCSE compared to English monolinguals. Multilingual learners exhibited a small improvement ($B = 0.681$, (3203.765) = 10.642, $p < .001$, $\beta = .146$). Simultaneous bilinguals also showed small but significant academic improvement by KS4 (B = 0.431, (3189.313) = 7.012, $p < .001$, $\beta = .096$).

These findings highlight the stability of academic performance and the possible positive impact of multilingualism on student outcomes at the secondary level.

Again, SAT results were used as a baseline, to analyse academic growth at GCSE in English, Maths, and Science, specifically examining the impact of multilingualism.

For English outcomes, the results indicated that baseline academic ability in English at SAT was a significant predictor of subsequent achievement at CGSE, ($B = 1.061$,(3203.789) = 41.534, $p < .00$), represented by a large effect size ($\beta = .598$).

In terms of language experience, multilingual learners showed significant improvement, (B = 0.537,(3194.134) = 7.328, $p < .001$), corresponding to a medium effect size ($\beta = .297$). Simultaneous multilinguals also displayed small gains (B = 0.334, (3166.506) = 4.769, $p < .00$, ($\beta = .184$).).

Similarly, SAT Maths scores were a robust predictor of GCSE achievement, (B = 1.155,(3202.154) = 58.107, $p < .001$) with a large effect size ($\beta = .706$). Multilingual learners (B = 0.433,(3173.253) = 5.982, $p < .001$, $\beta = .250$), and simultaneous bilinguals (B = 0.366, t(3139.145) = 5.183, $p < .001$, $\beta = .212$) showed small but significant gains in maths from SAT to GCSE.

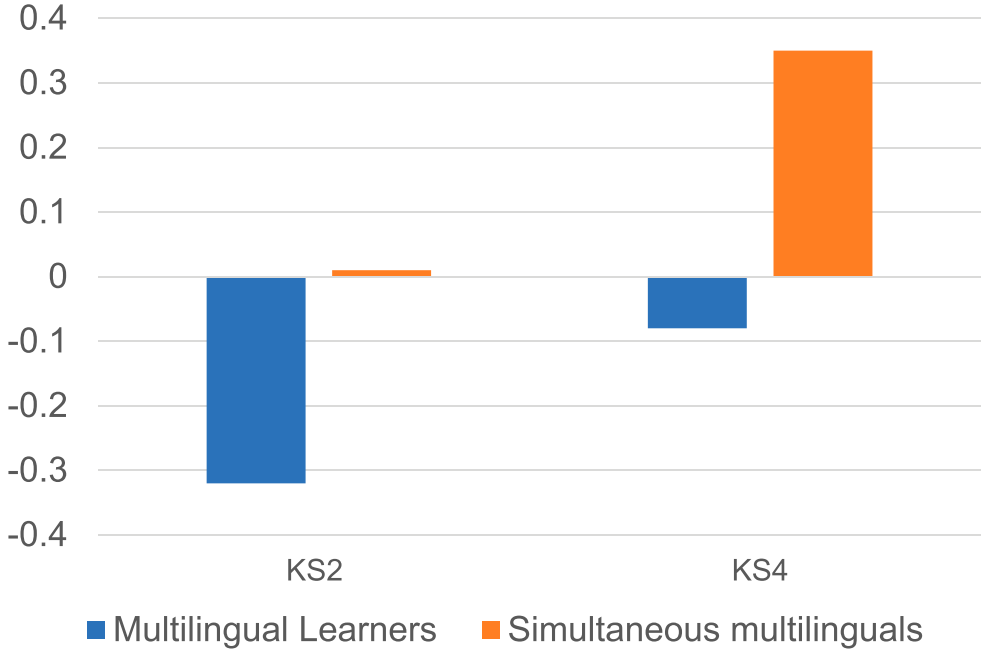

Figure 7. Overall difference in school performance of multilingual learners and simultaneous multilinguals in comparison to English monolinguals (set to 0).

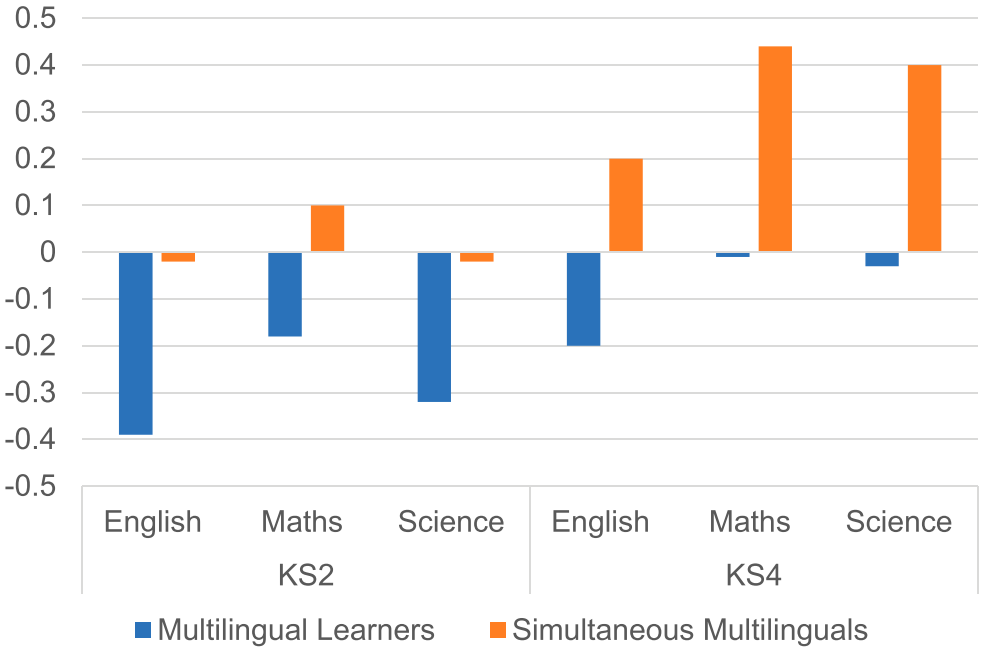

Figure 8. Subject-specific difference in school performance of multilingual learners and simultaneous multilinguals in comparison to English monolinguals (set to 0).

In Science, baseline SAT scores significantly predicted GCSE outcomes, (B = 1.059,(3203.211) = 36.217, $p < .001$), with a large effect size ($\beta = 0.534$).

Regarding language experience, multilingual learners exhibited substantial significant advantages, (B = 0.590,(3196.983) = 6.928, $p < .001$), a medium effect size ($\beta = .316$). Similarly, simultaneous multilinguals demonstrated an significant improvement (B = 0.558, (3175.463) = 6.796, $p < .001$), also a medium effect size ($\beta = .299$).

These findings, illustrated in Figure 7 and Figure 8, underscore the significant impact of early academic performance and particularly highlight the positive association between multilingual education and higher academic outcomes at GCSE.

Discussion

This study investigated the associations of language experience and socio-economic status (SES) with educational attainment across three core subjects, English, Maths and Science, at SAT, Key Stage 2 (KS2) and GCSE, Key stage 4 (KS4) in a sample of 3,213 pupils from the UK Study of Cognition, Adolescents and Mobile Phones (SCAMP) and the National Pupil Database. Pupils were categorised in three linguistic groups on the basis of their response to the question on the SCAMP questionnaire whether English was their first language, with three possible answers: (1) Yes, (2) No, and (3) English learned at the same time as another language. Those who responded yes were allocated to the English monolingual group, that is, students who speak only English from birth without significant exposure to other languages during early development. Those who responded 'no' were allocated to the multilingual learners' group, that is, students who are learning English as an additional language alongside their first language(s). These learners may have started learning English after developing foundational linguistic skills in their first language. Finally, those who were exposed to more than one language from birth or at a very early age, were categorised as simultaneous multilinguals.

Results summary

At SAT, multilingual learners exhibited significantly lower performance compared to monolingual peers across English, Maths, and Science, indicating consistent challenges. However, by GCSE, these learners closed the academic gap, showing no significant difference from their English monolingual peers. This rapid convergence in academic performance challenges the prevalent misconception that growing up multilingual is detrimental and that multilingual students require more than seven years to achieve parity with monolingual students (see Filippi and Bright 2023, for a discussion).

Simultaneous multilinguals, on the other hand, showed no significant differences in performance compared to English monolinguals at SAT, except a small positive effect in Maths. By GCSE, they not only caught up but frequently outperformed their monolingual peers, suggesting that early exposure to multiple languages can confer significant cognitive and academic advantages.

Impact of socioeconomic status (SES)

Eligibility for free school meals, a proxy for lower socioeconomic status, consistently showed a significant negative impact on performance on all pupils, with a larger effect size at GCSE compared to SAT. This reflects a consistent disadvantage for students from lower socioeconomic backgrounds and underscores the need for targeted interventions to support these students throughout their schooling. However, multilingual pupils demonstrated resilience against SES-related challenges. The absence of a significant interaction effect for simultaneous multilinguals at both SAT and GCSE is particularly notable. This could suggest that simultaneous multilinguals develop certain skills so early that they become somewhat robust against the variations in socioeconomic status. The connection between school attainment and either enhanced cognitive abilities or cultural variability remains unclear. However, the statistically significant interaction observed between simultaneous multilingualism and eligibility for free school meals suggests that multilingualism may offer some protective or enhancing effects on educational outcomes, even amidst socioeconomic challenges.

Linking to recent studies and contextual framework

Our findings dovetail with the nuanced conclusions drawn by Hessel and Strand (2021), who noted that multilingual students in the UK do not significantly underperform their monolingual peers in standardized tests. This challenges prevailing stereotypes about multilingualism being a detriment in educational settings and suggests that multilingualism may impart hidden cognitive benefits that are not directly measurable by traditional assessments. This perspective supports our observation that by GCSE, multilingual learners catch up to their monolingual counterparts, indicating that early educational assessments may not fully capture the long-term benefits of multilingual exposure.

Additionally, the research by Dai et al. (2023), which observed enhanced cognitive flexibility in students from multilingual settings, may be relevant to our GCSE observations, where students engaged in simultaneous multilingual learning appeared to achieve higher academic performance compared to their monolingual peers. However, further investigation is necessary to determine whether and how these observations are linked. The correlation between cognitive flexibility and academic achievement, if true, underpins the argument for the educational system to adjust teaching strategies to better harness these cognitive benefits.

Integration with multilingualism, education, and socioeconomic status studies

It is important to approach the relationship between cognitive abilities and academic performance with caution. While Filippi et al. (2022) have contributed valuable insights into the interplay between

socioeconomic status (SES) and linguistic experience, which emphasize the generally positive effects of multilingualism on cognitive abilities like working memory and non-verbal reasoning, particularly for students from lower socio-economic backgrounds, the translation of these cognitive benefits to academic success is not directly straightforward. Our study builds upon these observations by exploring how these cognitive enhancements might manifest in academic performance across various subjects by GCSE. Although our findings support the notion that SES consistently impacts performance negatively, suggesting that multilingualism may help buffer against socio-economic challenges, it is critical to note that such outcomes might not be solely attributable to cognitive abilities alone. This complex relationship necessitates further investigation to fully understand the underlying mechanisms and factors involved.

Furthermore, Winsler et al. (2023)'s study on the long-term academic outcomes of multilingual learners in Miami emphasises the benefits of early proficiency in a country's dominant language, particularly among low-income multilingual pupils. This aligns with our observation that simultaneous multilinguals, who develop language skills early, often maintain strong academic performance despite socio-economic challenges. This supports the notion that early bilingual exposure may not only aids in cognitive development but also provide a protective buffer against socioeconomic disparities in educational outcomes.

The convergence of these studies with our findings suggests a compelling narrative: while initial academic challenges for multilingual learners are evident, these challenges are often overcome by mid-adolescence. This trajectory underscores the need for educational policies that support early language development and recognize the long-term academic and cognitive benefits of multilingualism. Additionally, our findings advocate for a dynamic approach to bilingual education, integrating it as a fundamental component of educational strategies to mitigate the disadvantages associated with lower socioeconomic status and capitalize on the cognitive benefits of bilingualism.

By situating our results within the context of existing research, we provide a robust framework for understanding how multilingualism interacts with socio-economic factors to influence educational outcomes. This comprehensive approach not only validates our findings but also contributes to the broader discourse on enhancing educational policies to support diverse linguistic backgrounds.

The evidence suggests that bilingual education should not only focus on mitigating the initial academic challenges faced by multilingual learners but also on leveraging the inherent cognitive benefits of bilingualism for all students. This involves integrating bilingual programs that foster both language and cognitive development, as seen in successful implementations discussed by Tsimpli (2017) and others. Successful bilingual education strategies, such as dual-language immersion programs and integrated content and language learning (ICL), have shown promising results in various international contexts. For instance, programs like the two-way immersion model in the United States allow students to develop proficiency in both their native and a second language by receiving instruction in both languages. Similarly, the CLIL (Content and Language Integrated Learning) approach in Europe integrates subjects like mathematics or science with a foreign language, enhancing both content knowledge and language skills simultaneously. These models could serve as effective frameworks for schools aiming to harness the cognitive benefits of bilingualism while addressing the academic needs of multilingual students, particularly in diverse socioeconomic settings.

Future research directions

Further cross-cultural research is needed to explore the mechanisms underlying these patterns, including qualitative studies that delve into the experiences of multilingual and monolingual students, and longitudinal studies tracking individual student trajectories over time. Currently, we are analysing new data to investigate whether bilingualism is associated with a more general cognitive benefit, as argued by some researchers (e.g. Bialystok 2017), or whether there are alternative

explanations for this effect, such as socio-cultural factors and parental engagement in their children's education.

This research aims to provide a deeper understanding of how multilingualism intersects with socioeconomic status to influence academic outcomes and to develop more effective educational strategies that harness the cognitive benefits of bilingualism. Through these efforts, we hope to validate and elaborate on the cognitive benefits of bilingual education and its implications for broad educational practices.

The benefits of a multilanguage experience, evidenced by the academic convergence observed by GCSE, underscore the need for sustained research into how early linguistic exposure influences cognitive and academic trajectories. Future studies should aim to quantify these benefits further, exploring how early bilingualism can influence higher educational choices, career opportunities, and lifelong learning skills. Additionally, longitudinal data could help policymakers and educators develop timelines and benchmarks for integrating language learning into early education curricula, ensuring that benefits are maximised.

Conclusions

In conclusion, this study has demonstrated significant academic benefits associated with multilingualism, particularly for Simultaneous Multilinguals (SM), who consistently outperform their English Monolingual (EM) peers from SAT (Key Stage 2) through GCSE (Key stage 4). These findings challenge longstanding misconceptions about the academic disadvantages of growing up with multiple languages and highlight the protective and enhancing effects of bilingualism against socio-economic adversities.

Our research underscores the need for educational strategies that not only recognize but actively incorporate multilingualism to foster a more inclusive, equitable, and dynamic educational landscape. By integrating dual-language immersion programs and Content and Language Integrated Learning (CLIL), schools can leverage the inherent cognitive benefits of bilingualism, enhancing academic outcomes for all students, particularly those from lower socioeconomic backgrounds.

This study contributes to the growing body of evidence supporting bilingual education and offers a robust framework for future policy developments. It calls upon educational stakeholders to re-evaluate and adapt educational practices to better serve the diverse linguistic profiles of students, ensuring that multilingualism is seen as an asset rather than a challenge within educational systems.

As we continue to explore the complex interactions between language experience, cognitive development, and academic performance, it is imperative that we maintain a commitment to developing educational environments that embrace linguistic diversity, facilitate linguistic equity, and recognize the long-term benefits of bilingualism for all learners.

In light of these findings, we advocate for educational policies that not only recognise the value of multilingualism but actively integrate it into educational frameworks from an early stage. Specifically, policies should support the implementation of bilingual programs that cater to the diverse needs of multilingual students, ensuring equitable educational opportunities. Such initiatives are essential for fostering an educational environment that values linguistic diversity as a resource rather than a challenge, promoting inclusivity and enhancing cognitive and academic outcomes for all students.

Note

1. In the UK, Key Stage 2 SATs results used to be reported as National Curriculum levels, where a level 4 was considered a standard pass, but since 2016, this system has been replaced. Now, children are given scaled scores instead. The range for these scaled scores is typically from 80 to 120, with 100 set as the expected standard to meet. There is no longer a 1–6 grading scale in the current UK SATs system.

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Appendices

Appendix 1

Table A1. Number of pupils in each school along with the percentages of Multilingual learners, Native Bilinguals, and English Monolinguals. 'Total Pupils' represents the total number of pupils in the school. School ID represents the identifier of each school. Multilingual learners %, Native Bilinguals %, and English Monolinguals % represent the percentage of each linguistic group within the school.

School ID	Total Pupils	Multilingual learners %	Simultaneous Multilinguals %	English Monolinguals %
6	143	29	38	32
18	107	30	31	39
46	141	29	26	45
157	251	25	26	49
163	197	19	55	25
194	181	4	4	91
195	166	48	27	25
196	108	32	61	6
197	154	31	38	32
198	144	24	25	51
199	159	9	8	83
200	147	12	20	69
201	113	33	15	52
202	84	29	12	60
203	162	36	33	31
204	140	9	14	77
206	122	34	37	30
207	137	23	31	47
208	69	20	36	43
209	151	8	13	79
217	39	31	33	36
218	67	4	7	88
219	124	6	9	85
221	64	16	9	75
222	43	47	28	26

Appendix 2

Table A2. Overall mean results and standard deviations at KS2 and KS4.

Language Group	KS2 (Mean/SD)	KS4 (Mean/SD)
Multilingual Learners	4.14/0.72	4.97/1.72
Simultaneous Multilinguals	4.47/0.56	5.40/1.66
English Monolinguals	4.46/0.58	5.05/1.82

Table A3. Mean results and standard deviations by subject at KS2 and KS4.

	KS2			KS4		
Language Group	English (Mean/SD)	Maths (Mean/SD)	Science (Mean/SD)	English (Mean/SD)	Maths (Mean/SD)	Science (Mean/SD)
Multilingual Learners	4.03/0.78	4.32/0.86	4.07/0.75	4.84/1.69	4.96/2.01	5.12/1.93
Simultaneous Multilinguals	4.40/0.58	4.60/0.79	4.37/0.62	5.24/1.68	5.41/1.93	5.55/1.90
English Monolinguals	4.42/0.60	4.50/0.81	4.39/0.62	5.04/1.80	4.97/2.07	5.15/2.03

Appendix 3

Table A4. This table displays the hierarchical multilevel model results for SAT and GCSE assessments. Each level represents a progression in model complexity, and sequentially incorporating main effects, free school meals, and interaction terms. This table presents the coefficients of key predictors, their statistical significance, model fit statistics (AIC and BIC), variance attributed to random effects, and convergence status for each level of the analysis. The structured approach highlights the incremental impact of each variable addition on the overall model's explanatory power and fit.

	SAT (KS2)								
	English			Maths			Science		
	Model A	Model B	Model C	Model A	Model B	Model C	Model A	Model B	Model C
Fixed Effects									
Multilingual Learners	−0.665, 0.054, $p < 0.01$			−0.271, 0.069, $p < 0.01$			−0.529, 0.055, $p < 0.01$		
Simultaneous Multilinguals	−0.039, 0.053, $p = 0.469$			0.233, 0.069, $p < 0.01$			−0.013, 0.055, $p = 0.815$		
Free School Meals		−0.475, 0.069, $p < 0.01$			−0.558, 0.089, $p < 0.01$			−0.465, 0.071, $p < 0.01$	
Interaction Multilingual Learners * Free School Meals			0.479, 0.123, $p < 0.01$			0.185, 0.158, $p = 0.243$			0.424, 0.126, $p < 0.01$
Interaction Simultaneous Multilinguas * Free School Meals			0.231, 0.108, $p = 0.03$			0.134, 0.139, $p = 0.336$			0.168, 0.111, $p = 0.130$
Random Effects									
School ID		0.045. 0.015, $p = 0.004$			0.049, 0.19, $p = 0.01$			0.044, 0.015, $p = 0.004$	
Akaike's Information Criterion (AIC)		9390.318			11030.13			9544.792	
Bayesian Information Criterion (BIC)		9448.918			11078.73			9593.391	
	GCSE (KS4)								
	English			Maths			Science		
	Model A	Model B	Model C	Model A	Model B	Model C	Model A	Model B	Model C
Fixed Effects									
Multilingual Learners	−0.210, 0.096, $p = 0.029$			0.111, 0.111, $p = 0.318$			0.022, 0.108, $p = 0.835$		
Simultaneous Multilinguals	0.246, 0.095, $p = 0.01$			0.590, 0.110, $p < 0.01$			0.491, 0.107, $p < 0.01$		
Free School Meals		−1.084, 0.124, $p < 0.01$			−1.301, 0.143, $p < 0.01$			−1.212, 0.138, $p < 0.01$	
Interaction Multilingual Learners * Free School Meals			0.645, 0.219, $p = 0.003$			0.201, 0.253, $p = 0.426$			0.402, 0.245, $p = 0.101$
Interaction Simultaneous Multilinguas * Free School Meals			0.500, 0.192, $p = 0.009$			0.437, 0.223, $p = 0.050$			0.488, 0.216, $p = 0.024$
Random Effects									
School ID		0.212, 0.068, $p = 0.002$			0.251, 0.081, $p = 0.002$			0.344, 0.107, $p = 0.001$	
Akaike's Information Criterion (AIC)		13110.625			14041.155			13839.075	
Bayesian Information Criterion (BIC)		13159.224			14089.755			13887.675	