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Effective Pre-School, Primary and Secondary Education Project (EPPSE 3-14)

Influences on Students' Attainment and Progress in Key Stage 3: Academic Outcomes in English, Maths and Science in Year 9

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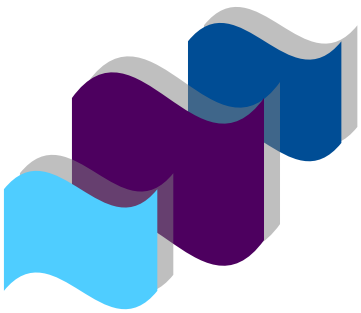

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The views expressed in this report are the authors' and do not necessarily reflect those of the Department for Education

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Executive Summary

The Effective Pre-School, Primary and Secondary Education (EPPSE 3-14) project represents the secondary school phase of a major longitudinal study that had started in 1997. The original first phase of the research, the Effective Provision of Pre-school Education (EPPE1997-2003) project, was designed to explore the impact of pre-school on children's cognitive and social-behavioural outcomes, as well as other important background factors (family and home learning environment). For this purpose, a pre-school sample was recruited to the study at age 3 years. Subsequently, this project was extended and the same sample was followed through primary school from age of seven to age eleven - Key Stage 1 (KS1, Year 2) and Key Stage 2 (KS2, Year 6). An additional 'home' sample of children (who had not attended pre-school) was recruited at the start of primary school and was followed similarly with the pre-school sample up to age fourteen. The EPPSE 3-14 project is an extension of this initial research and follows the same sample (pre-school and 'home' children) during KS3 of secondary schooling (to the end of Year 9) at age 14 years plus.

The research design of this project has been based on an educational effectiveness and mixed methods approach (Sammons et al., 2005; Siraj-Blatchford et al., 2006). This type of design allows for the study of individual, family and home influences on cognitive and developmental outcomes. Furthermore, the relative importance of specific background influences can be investigated in relation to the strength of pre-school, primary and secondary school factors.

The report presents the results of analyses related to the influence of pre-school, primary and secondary school on pupils' cognitive attainments at the end of Year 9 when the young adults were aged fourteen, and their academic progress from the age of 11 to age 14 during KS3. The findings also extend and develop the findings from previous earlier ages. A report on pupils' social-behavioural development throughout the same period will be presented separately (Sammons et al., 2011a).

Throughout its research, EPPSE 3-14 has gathered a wide range of data on children's development, individual, family, home learning environment (HLE), pre-school and primary school characteristics. Additional measures of secondary school's academic effectiveness[1] derived from KS2-KS4 contextual value added (CVA) indicators produced by the DfE have been added to the EPPSE data set. Also, various Ofsted inspection judgements were used to provide independent indicators of the quality of secondary schools. These were used to complement the measures of quality[2] and effectiveness[3] for pre-school settings and the measures of primary school effectiveness[4]. It was therefore possible to explore pre-school, primary and secondary school influences on pupils' outcomes in Year 9.

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[1] Independent indicators of secondary school academic effectiveness and quality were obtained from the Department for Education. The measure of academic effectiveness is represented by the average KS2 to KS4 contextual value added (CVA) school level score over 4 years (2006-2009) during which the EPPSE students were in secondary school. The measure of secondary school quality was derived from various Ofsted inspection judgments.

[2] Pre-school quality was measured for each pre-school centre using the aggregate score from the ECERS-E (see Glossary) across scores for the curricular activities of Literacy, Numeracy, and Science/knowledge of the world, and on Diversity of provision for children of different abilities, gender and cultures (Sylva et al., 1999).

[3] Measures of the effectiveness of individual pre-school centres were derived from value added models of the EPPE 3-11 children's actual progress during the pre-school period, controlling for prior attainment and children's background characteristics (Sammons et al., 2004a). That is, children's cognitive progress was analysed from age 3 to rising 5 years.

[4] Independent indicators of primary school academic effectiveness were obtained from the analysis of National Assessment data for several cohorts across all primary schools in England. Mean value added scores of school academic effectiveness across the years 2002 to 2004 were calculated for each primary school in England and then extracted for schools attended by children in the EPPE 3-11 sample. These

National curriculum levels awarded for Teacher Assessment (TA) in English, mathematics and science have been used to provide measures of pupils' educational outcomes in Year 9 and standardised scores of National Assessments in English and mathematics in Year 6 have been used as measures of prior attainment. The sample included 3002 pupils for whom we had at least three cognitive assessments from age 3 to age 14.

The aims of the research were to:

- Investigate the relationships between pupils' cognitive attainment in KS3 (Year 9, age 14) and background individual, family and home learning environment (HLE) characteristics.
- Explore the influence of pre-school, primary and secondary school experiences, particularly in terms of quality and academic effectiveness on later cognitive outcomes and academic progress.
- Examine the combined impact of pre-school characteristics with the (HLE) and primary school experience on cognitive attainment.
- Assess whether the impact of pre- and primary school differs for more and less disadvantaged children.
- Investigate the combined effect of secondary school experience with pre- and primary school experiences on cognitive attainment.
- Model pupils' current cognitive *attainment* in Year 9, and their *progress* over KS3.
- Explore the effects of teaching, school processes and pupils self perceptions on cognitive attainment.

Summary of Findings

This report provides a detailed investigation of the cognitive attainments of the EPPSE sample of pupils at the end of KS3. It builds on earlier research that has followed this group from early childhood at age 3 years through primary school and into secondary school up to age 14.

Previously the project has demonstrated that a range of factors related to child and family characteristics and the home learning environment are important predictors of children's cognitive attainments and progress up to the end of primary school (Sammons et al., 2008a; Sylva et al., 2010). The impact of these influences can be detected from a young age and can also affect later educational attainment. The variations in achievement point to the negative effects of socio-economic disadvantage and the results of the research have contributed to policy developments in England associated with issues of equity and social inclusion (see The Equalities Review, 2007).

This current follow up of the sample in adolescence (Year 9 age 14) provides new evidence about the size of the equity gap in attainment as measured by teachers' judgements of pupil attainment in the three 'core' curriculum areas of English, mathematics and science (reflected by differences in TA levels).

In contrast to earlier research on this sample (during KS2), it was not possible to study variations in pupils' KS3 attainment using national assessment test scores as outcomes, due to a change in education policy. Instead, the analyses presented in this report are based on TA judgments that are less finely differentiated than test scores and tend to reflect greater subjective bias due to possible 'halo effects' (see Bew, 2011; Harlen, 2004). However, teacher judgments of attainment in Year 9 is likely to play an important role in shaping pupils' future educational decisions and subject

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value added measures provide indicators of a school's academic effectiveness in terms of National Assessment outcome.

choices in KS4 and therefore, can be viewed as important measures of educational outcomes to investigate.

The analyses in this report identify which child, family and home learning factors predict EPPSE pupils' KS3 outcomes. The results show similarities to earlier findings for this sample. A brief summary of the main findings is presented. While many results on the impact of gender, parents' qualifications or SES are in accord with those from other educational research studies, EPPSE also reveals the continued importance of the early years Home Learning Environment (HLE). The EPPSE project is unique in its exploration of the influence of this factor across different phases of pupils' education and has identified the way that the early years HLE continues to predict attainment up to age 14. In addition, the latest research discussed in this report demonstrates that various family background factors continue to influence pupils' academic progress across KS3. It should be noted that in the progress analyses, prior attainment in national assessment tests taken at the end of primary education (Year 6, KS2) was used included as a baseline in the statistical models.

This report focuses on statistical trends and quantitative analyses of factors that predict attainment and progress in KS3 based on results using multilevel statistical models. Elsewhere, EPPSE has reported (in keeping with the mixed methods research design involving both quantitative and qualitative approaches) findings from qualitative case studies of children and families that are more educationally successful in overcoming disadvantage (see Siraj-Blatchford et al., 2011). The qualitative data helps to provide a broader understanding of the way social disadvantage shapes pupils' educational outcomes and experiences at different ages and what factors help to protect against the adverse consequences of disadvantage.

As well as investigating the impact of child, family and HLE background, the EPPSE research has explored the continued influence of pre-school and primary school as predictors of pupils' later attainment at age 14 and also tested a range of measures related to secondary school experiences. The results, therefore, provide new evidence on the way different educational settings (pre-school, primary and secondary school) affect attainment and progress in KS3.

In order to maximise the sample size in our analyses, multiple imputation of missing data was used. Careful comparison of the results from both imputed and non imputed data sets were conducted and indicate that the results are robust producing very similar and the patterns consistent.

Raw Differences in Attainment for Different Pupil Groups

Overall, EPPSE pupils' had higher average attainments in mathematics than in either science or English (a difference of around 0.5 of a national curriculum level comparing mathematics and English, and 0.36 of a level comparing mathematics and science) at the end of KS3. This pattern of higher results in mathematics is in line with the most recent international TIMSS survey (Martin et al., 2008; Mullis et al., 2008; Sturman et al., 2008) of mathematics and science achievement that revealed England as the highest performing country in Europe in mathematics with the most improved results since 1995. It is likely that this improvement is linked with the introduction of the National Numeracy Strategy in 1998 (DfEE, 1998). In interpreting the KS3 results, it should be noted that EPPSE pupils had experienced the numeracy strategy in their primary education.

Gender

In Year 9, girls had higher attainment in terms of average TA English results than boys by around 0.4 of a national curriculum level (approximately half a standard deviation in size), but there were no significant gender differences in mathematics or science results. At younger ages, girls had been shown to have higher attainment in Reading and English and there were also smaller differences in mathematics and science outcomes in primary school but by age 14 these differences have disappeared.

Ethnicity
There was some evidence of ethnic differences in attainment but due to low numbers for most groups in the EPPSE sample the results should be interpreted with caution. Nonetheless, the differences found in average results by ethnic group are in line with those evident in other studies indicating higher attainment for some groups e.g. Indian and lower for others e.g. those from Pakistani heritage.

Family Characteristics
There were marked differences in attainment related to parents' qualification levels. As might be anticipated, pupils with highly qualified parents (degree level) had much higher attainment on average than those pupils whose parents had no qualification (the difference was equivalent to 1.4 TA levels for English, 1.7 for mathematics and 1.5 for science).

There were similarly large differences related to family socio-economic status (SES) between those from professional non-manual and those from lower SES categories. Moreover, pupils eligible for Free School Meals (FSM) had lower average attainment than pupils who were not eligible for FSM. The differences were around 0.7 and 0.8 of a national curriculum level in each subject.

Differences in the Early Years HLE were also associated with later differences in average attainment Year 9. The difference for English and science was approximately 1 national curriculum level, for mathematics it was 1.3 of a level for those of high versus low scores.

The Net Impact of Child, Family and HLE Factors on Attainment in Year 9
The average group differences described above do not take into account the relative influence of other characteristics. Multilevel modelling provides more detailed results of the 'net' contribution of individual factors, whilst controlling for other predictors and so enables the identification of the 'strongest' net predictors. For instance, we show the higher attainment in students with mothers who have degrees compared to those with no qualifications, net of the influence of other family and child factors (SES, income, HLE or gender).

Mother's qualification level was the strongest predictor of better attainment for English, maths and science. The next strongest predictor was gender but for English only, where the effect was larger in KS3 than was the case when these students were in primary school.

There were also a number of additional strong/moderately strong predictors as follows for:
English: family income, birth weight, father's highest qualification level, and the Early Years HLE;
Mathematics: birth weight, Early Years HLE, father's qualification level, ethnicity and family SES;
Science: father's qualification level, Early Years HLE, family SES and ethnicity.

It should be noted that ethnicity was not a significant predictor of TA levels in English, but it was for mathematics and science; pupils of Indian heritage obtained significantly better results in mathematics and science than White British pupils. Both FSM (the low income indicator) and family SES also have moderate effects on English, mathematics and science. These effects were similar in size to the effects of the Early Years and KS1 HLE for English. The Early Years HLE had a stronger impact on pupils' KS3 mathematics and science attainment than the low income indicator FSM.

Older students (for their age group e.g. Autumn born) also showed better results though the effect was not strong. There were also small positive effects related to the age of the child's mother (at birth); the older the mother then the better the outcomes, compared to children of younger mothers.

There is evidence that the 'social composition' of the school (as measured by the percentage of students entitled to free school meals, an indicator of poverty) can affect individual pupil's

outcomes over and above their own FSM status. EPPSE students who attended a secondary school with higher proportions of students receiving FSM showed poorer attainment in English, maths and science, although the effects were relatively weak.

These results broadly confirm patterns identified at younger ages indicating that differences in attainment related to individual pupil and family background influences emerge early (at age 3) and remain fairly stable as pupils progress through primary and secondary school. The results supporting this conclusion are well established in previous social and educational research.

Neighbourhood Influences

A number of neighbourhood measures were tested as potential predictors of pupils' KS3 cognitive attainments. Previous research has suggested that contextual influences outside the family (such as school and neighbourhood composition) may influence student attainment. Living in a disadvantaged area and attending a school with a higher representation of disadvantaged pupils, may affect pupil and family aspirations and attitudes to education and also teacher expectations.

The DfE's national Contextual Value Added (CVA) measure of school performance has demonstrated that the school measure (percentage of FSM pupils) and neighbourhood measures such as the IMD and IDACI score predict pupil progress. As noted above the percentage of pupils on FSM in a secondary school also predicted attainment for the EPPSE sample.

Levels of neighbourhood disadvantage (measured by the IMD - Noble et al., 2004; and IDACI - Noble et al., 2008) were also significant predictors of lower student attainment in English and science in Year 9. This was not the case during the primary school years, possibly because neighbourhood influences increase as adolescents interact more with their peer group outside the home. Students who live in disadvantaged neighbourhoods had poorer attainment, over and above their own and their family characteristics, although these neighbourhood effects are relatively small compared to those of the family.

Other neighbourhood measures were also obtained by the EPPSE research. These included the level of employment and the percentage of residents with limiting long term illnesses, but neither of these was found to predict pupils' attainment. In contrast, the percentage of the population who were classed as White British was statistically significant with small negative effects for each subject. The level of crime recorded in a neighbourhood was also found to have small negative effects on attainment and progress in English and science. Similarly, parents' perceptions of the safety of their neighbourhood also showed small positive effects on attainment (mathematics and science) and progress (science).

Taken together the results indicate attainment was lower for pupils who lived in more disadvantaged neighbourhoods compared to those in more advantaged neighbourhoods, over and above their own and their family characteristics. The neighbourhood influence though relatively small seems to have become stronger in as the EPPSE sample go through early adolescence.

Pre-school

The EPPSE research was designed to follow up children recruited at pre-school into primary and later secondary school in order to identify and investigate the contribution of different educational influences on their later progress and development in different phases of education. In addition to investigating individual pupil, family, home learning and neighbourhood, further analyses sought to establish whether pre-school influences identified as significant predictors of attainment and progress in both cognitive and social behavioural outcomes at younger ages still show effects nine years later when the variation in attainment is studied up to age 14 years.

Three measures were tested: whether or not the pupil had **attended** a pre-school (a comparison with the 'home' group); the **quality** of the pre-school attended (as measured by the ECERS-R and E environmental rating scale instruments) and the **effectiveness** of the pre-school attended.

Attendance
Just having attended a pre-school was found to be a statistically significant predictor of better attainment in both maths and science (but not English) at the end of KS3, compared with the 'home' group. Although relatively weak (ES=0.26 for mathematics and ES=0.22 for science), these effects were still stronger than those found for 'age' (being Autumn born) and similar to the effect for family income (in both mathematics and science).

Quality
The quality of pre-school also continued to predict better outcomes in mathematics and science nine years after leaving pre-school. The effects of medium and high quality were slightly larger than for low quality (compared to 'home' group). For example, the ES for high quality was 0.28 for mathematics. In science, only those who had attended a medium or high quality pre-school continued to show significantly better attainment than the home group in TA levels at age 14.

Effectiveness
The indicator of pre-school effectiveness in promoting pre-reading skills continued to predict better outcomes in English in lower secondary school. However, only the highly effective category was statistically significant (ES=0.20) in predicting better attainment when compared to the 'home' group.

For mathematics, all groups (ES=0.36 for high; ES=0.22 for medium; and ES=0.30 for low effectiveness) had significantly better results than the 'home' group after controlling for other factors. For science, attending a high (ES=0.33) or medium effective (ES=0.19) pre-school (in promoting early number concepts) predicted significantly better outcomes than not attending a pre-school. Those attending a low effective pre-school showed no better outcomes in science by the end of KS3 than the 'home' group.

Primary School Influence
Previous EPPSE research has shown that the academic effectiveness of a child's primary school is a statistically significant predictor of better attainment and progress across KS2 for English and more strongly for maths. Other educational effectiveness research has shown that primary schools can continue to influence students' longer term academic outcomes at secondary school (Goldstein & Sammons, 1997; Leckie, 2009). Measures of the academic effectiveness[2] in English and maths of the primary school attended by the EPPSE students were explored to see whether they had a positive influence on later attainment at the end of KS3. The KS3 analyses reveal that the academic effectiveness of the primary school the EPPSE students had attended still predicted better outcomes for both maths and science attainment three years after transferring to secondary school.

Controlling for pupil, family and HLE background characteristics, by the end of KS3, the extra benefit of attending a medium effective primary school was relatively small compared with the low effective group (ES=0.13 for maths & 0.10 for science). The net effects of attending a high academic effective primary school on later attainment compared with the effects of attending a low effective one were rather stronger (ES=0.31 for maths & 0.29 for science). The effects are similar in size to those attributable to FSM. The effect in terms of TA levels is a third of a level for maths and a quarter of a level for science.

Combined effects of phases of education
Pre-school and HLE

Further analyses also explored joint effects of pre-school and the Early Years HLE. The results showed that those with a low Early Years HLE obtained better outcomes in terms of later English, mathematics and science if they had attended a pre-school. The net differences were equivalent to between 0.4 and 0.7 of a national curriculum level (ES=0.37 for English; ES=0.56 for mathematics and ES=0.48 for science).

The quality of the pre-school measured by ECERS-E no longer showed differences in relation to pupils' Early Years HLE for English, mathematics or science in Year 9, in contrast to findings from the primary school.

There was an indication that the effectiveness of the pre-school in promoting early number concepts mattered in the study of joint effects for later science in Year 9. Here for both the low and the high HLE group there was evidence of a trend. Those with a low Early Years HLE showed particular benefits if they had previously attended a high effective pre-school (ES=0.61) showing similar results in terms of boost to those who had a medium or high HLE who had not attended pre-school. These results again suggest that high effective pre-school experience may have some compensatory benefits in promoting better later cognitive outcomes in science up to age 14.

Primary-school effectiveness and parent's qualification level
Further analyses explored joint effects for different pupil groups. For pupils whose parents had low educational qualifications, the boost in mathematics predicted from attending a high effective primary school compared with a low effective one was also larger (difference in ES=0.33) than the boost provided for pupils of parents with higher qualification levels (difference in ES=0.17). A similar pattern of results was found for science Year 9 TA levels. This suggests some continuing compensatory impact of previous attendance of a more academically effective primary school for pupils whose parents have lower educational qualifications.

Primary school and pre-school
The joint effects of pre-school quality and the primary school effectiveness were also investigated. These also pointed to the continued benefits of primary school academic effectiveness even when pre-school effects are taken into account for both mathematics and science outcomes in Year 9.

Pre-school effectiveness (in promoting early number concepts) was tested jointly with the primary school academic effectiveness measure and the results indicated that attending a high effective pre-school offered some protective effects (even if a student went on to a less effective primary school) for later maths and science outcomes. Likewise, having attended a more academically effective primary school mitigated the effects of experiencing no or only a low effective pre-school. The longer term protective effects of pre-school effectiveness were shown most clearly for students who then attended a low academically effective primary school when we studied their later attainment in Year 9 of secondary school.

Secondary and pre-school effectiveness
Further analyses of the combined effects showed that the continued benefits of pre-school were most evident for EPPSE students who went on to attend medium or low effective secondary schools, suggesting a protective influence of pre-school against attending an ineffective secondary school.

Transition from Primary to Secondary School
A subsample of approximately 550 EPPSE pupils and parents were asked about their personal experiences and views related to the transition from primary to secondary school, including their settling down in the new school, the academic work, their friendships and things that primary/secondary schools did to assist or smooth the transition. Five factors were identified to be deemed salient in the transition (Evangelou et al., 2008 for full details):

- Developing friendship, self-esteem and confidence
- Settling into school life

- Showing interest in school and schoolwork
- Getting used to new routines
- Experiencing curriculum continuity

EPPSE examined the importance of the transition experience on subsequent achievement and found that, those students who settled quickly into school routines and who experienced continuity in the curriculum from primary to secondary school made better progress in maths and science across KS3 and also had higher attainment in all three core subjects at Year 9. Although statistically significant, these effects were relatively small (ES range between 0.21 and 0.32). Other transition factors were less predictive of school-success, suggesting that familiarity with the school building and routines, along with familiar curriculum materials in lessons were more important during transition than the psychological dimensions of self-esteem and confidence or the social dimension of settling into school (social) life.

Primary School Mobility

The present report also explored the relationships between mobility during KS1 and KS2 in primary school and pupils' later cognitive outcomes in KS3. Results showed that mobility during KS2 was a negative predictor of Year 9 TA levels in English, mathematics and science. Pupils who had changed primary school only during KS2 obtained lower levels of Year 9 TA in all three core areas of the curriculum English, mathematics and science, even when the analyses controlled for the influence of a range of pupil and family background characteristics, HLE, neighbourhood disadvantage and school level FSM. Additionally, for mathematics, mobility during KS1 was also found to be a negative predictor of lower levels of TA in Year 9. Pupils who had moved primary schools during KS1 obtained significantly lower levels of TA in mathematics in Year 9 than pupils who had not moved at all.

Overall, these analyses of EPPSE pupils' attainment in English, mathematics and science in Year 9 has provided a wide range of evidence concerning the factors that predict attainment in Year 9 as measured by TAs, and also progress across KS3.

Secondary School Influences

We tested the academic effectiveness of secondary schools using CVA measures derived from the DfE's National Pupil Database. These measures show the relative progress made by pupil intakes measured from KS2 to KS4 (across 5 years). In contrast to our primary school academic effectiveness measure that examined results in English, mathematics and science separately (Melhuish et al., 2006), we did not have subject specific results for these secondary school CVA indicators. The secondary school CVA measure of effectiveness did not predict EPSSE pupils' differences in attainment in Year 9, after controlling for individual pupil, family and HLE measures.

However, after controlling for the same characteristics, the quality of secondary school measured by Ofsted inspection ratings on the 'quality of pupils' learning' was a statistically significant predictor of attainment in both English and science, with the difference being only statistically significant (but moderately strong) for the 'outstanding' schools category compared with the 'inadequate' category (ES= 0.42 English, ES=0.51 science).

For mathematics, schools judged by Ofsted as 'good' (on quality of learning) showed more modest but significant positive effects (ES=0.26) and those judged as 'outstanding' showed stronger effects (ES=0.56) compared with the 'inadequate' category.

These results support the hypothesis that secondary school quality remains important in shaping pupils' cognitive attainment, over and above the impact of background factors. The effects are equivalent to between 0.34 and 0.64 of a TA level for those who attended an 'outstanding' rather than an 'inadequate' school (in terms of the Ofsted judgement 'quality of learning'). A similar

strong pattern was identified for Ofsted judgments of learners' attendance. It should be noted that these two Ofsted measures (quality of learning and learners attendance) are also correlated.

Pupils' Progress across Key Stage 3

Pupils' academic progress across KS3 was studied by controlling for the prior attainment at the end of primary school and taking account of individual pupil, family and HLE factors. Fewer background factors predicted progress across KS3 than were significant for attainment. The patterns were similar to those found to be at younger ages when we studied pupils' progress across KS2 for this sample.

Overall, there was evidence that pupils:

- older for their year group (Autumn born) (ES=0.24-English, ES=0.32-maths and ES=0.20-science),
- girls (ES=0.32-English, ES=0.16-maths and ES=0.17-science),
- with highly qualified fathers (ES=0.28-English, ES=0.28-maths and ES=0.43-science),

made more progress in English, maths and science over KS3.

Students whose mothers were highly qualified (degree/higher degree) made better progress in English (ES=0.34) and science (ES=0.33). Additionally, students whose families had high incomes also made better progress in English (ES=0.39). There were small negative effects related to early behavioural problems, and eligibility for FSM.

A higher percentage of students in a school eligible for FSM predicted poorer progress for the EPPSE sample in both English (ES=0.18) and science (ES=0.21). Of the neighbourhood measures tested, only the percentage of White British and the level of reported crime were significant predictors of poorer student progress in English. For progress in science however, reported crime, perceived neighbour safety, the IMD and IDACI were statistically significant predictors. These findings indicate that the disadvantage of the school's intake and pupils' neighbourhood characteristics had small negative effects predicting both poorer progress and attainment and shows that schools in some areas face more challenging circumstances in improving student learning outcomes.

Neither the pre-school measures nor the primary school academic effectiveness measure were significant predictors of pupils' progress in KS3. However, the secondary school overall academic effectiveness indicator was found to be a statistically significant predictor for progress in English.

Higher Ofsted measures of the 'quality of pupils' learning' and 'attendance of learners' also proved to be significant predictors of better progress in all three core subjects. EPPSE students who attended an 'outstanding' secondary school in terms of the 'quality of learning' made significantly more progress in the three core subjects than those in schools judged to be 'inadequate' (ES ranged between 0.29 and 0.36). Additionally, students from secondary schools characterised as 'outstanding', 'good' or even 'satisfactory' in terms of 'pupils' attendance' made significantly more progress in English (ES=0.48 for outstanding) and mathematics (ES=0.35 for outstanding). These findings provide some evidence of external validity for the use of Ofsted inspection judgments and are in line with earlier results on a sub-set of primary schools investigated as part of the EPPE 3-11 phase of the research (Sammons et al., 2008c).

Pupils' experiences and views of secondary school

Pupils' secondary school experiences were measured using self-report questionnaires administered in Year 9. Various measures of school experiences were identified and tested to see if they predicted variations in pupils' KS3 academic attainment and progress after control for individual, family and HLE factors, including the percentage of pupils on FSM in the school.

The results indicate that students who perceived their school to place higher 'emphasis on learning' had significantly higher attainment. The difference was between half in English and science to three quarters of a TA level for mathematics (ES ranged between 0.20 and 0.22).

EPPSE pupils' attainment was also found to be higher where they perceived a more 'positive behaviour climate' in their secondary school. The difference was particularly noticeable for mathematics (ES=0.46). The perceived quality of their 'school environment'[5] was also a predictor of better attainment, although the effects were smaller and only significant for maths and science (ES=0.13 for both). Similar, small but positive effects were identified for the factor related to students' perceptions of how much they felt teachers' valued and respected them. Finally, the factor 'learning resources' (related to whether students felt the school was well equipped with computers and technology) also predicted better attainment in maths (ES=0.13) and science (ES=0.15) in KS3. Although the effect sizes are relatively small, this is the equivalent of around half a TA level for both these subjects.

After testing these factors separately as predictors of attainment, we also tested them together to investigate which ones are the most important in predicting cognitive outcomes in Year 9 when still controlling for individual pupil, familial and HLE characteristics. . For all three core curriculum subjects, it was found that the two factors 'emphasis on learning' and 'behaviour climate' together significantly predicted Year 9 cognitive attainment.

Looking only at pupils' progress during KS3 'behaviour climate', 'valuing pupils' and 'teacher support' were significant predictors of progress in English, maths and science. 'School environment and 'learning resources' were only significant for maths and science. 'Headteacher qualities' was a significant predictor for progress in maths (ES=0.15). Finally, 'teacher behaviour management' was a significant predictor of progress in science (ES=0.14).

After control for individual, family and HLE influences, the daily time spent on homework, as reported by students, was found to be an important and strong predictor of better attainment and progress. The strongest effects were noted for those who reported 2-3 hours per day. For attainment in English this had an ES of 0.73 (equivalent to 0.6 of a TA level). For attainment in mathematics, the ES was 0.84 (equivalent to almost 1 TA level) similar to the effects for science (ES 0.85, equivalent to nearly 0.75 of a level). For academic progress in the three core subjects, the ES for 2-3 hours of homework/day ranged between 0.69 and 0.84. Spending more time on homework is likely to increase study skills and opportunities to learn, it may also be influenced by self-regulation. It is also likely to reflect secondary school policies and teacher expectations and the academic emphasis in the school as well as encouragement from parents to take school work seriously.

Students' views of themselves

Earlier EPPSE research (Sammons et al., 2008d) has shown positive relationships exist between academic self-concept and attainment. Higher academic self-concept predicts better attainment and vice versa. Patterns of attainment and self-concept in younger children can shape their future identities as learners. The results for EPPSE students in secondary school show fairly strong links between academic self-concept in maths as a predictor of attainment in Year 9 (ES=1.2; nearly 1 TA level). By contrast, academic self-concept in English was a weaker predictor of Year 9 English attainment (ES=0.74; equivalent to approximately a half of a TA level). Students' self-reported enjoyment of school, also predicted attainment, with stronger effects for maths (ES=0.38 mathematics; ES=0.31 science; ES=0.29 English).

[5] This factor includes attractive and well decorated buildings, cleanliness of toilets etc.

Implications

The socio-economic characteristics of the individual student's family continue to influence academic attainment at the end of KS3 in the three core curriculum areas. This research also provides evidence that the school and neighbourhood in which students are positioned, can also affect outcomes. The early years HLE remains an important predictor of better attainment at age 14 and this has relevance for the development of policy regarding families and parenting. The research has implications for the debate on the drivers of social inequality and has messages for both policy and practice that may help to narrow the gap in educational outcomes and improve children's and young people's learning over their life course.

In addition, the specific characteristics of educational institutions predict attainment up to the end of KS3. Firstly, the child's experiences within a pre-school centre continue to predict attainment through primary and into secondary school. There are continuing effects of pre-school attendance and also of pre-school quality and effectiveness, particularly for later attainment in maths and science. This is relevant to the development of policies which increase the quality and effectiveness of pre-school and is especially important given the increased numbers of children who now take up their funded place.

The findings also provide evidence that the academic effectiveness of their primary school not only influences EPPSE students' attainment and progress during KS2, but also continues to predict better outcomes in maths and science later on in KS3. This shows the relevance of educational effectiveness (CVA) indicators (of primary school performance in specific subjects) for both policy makers and practitioners in providing useful information to help evaluate institutions. Other research has also demonstrated that more effective schools tend to make greater use of performance data to help improve their practice (Day et al., 2009).

There is also evidence of secondary school effects on students' progress across KS3. The Ofsted inspection indicator of school 'quality' predicts both attainment and progress over and above individual, family, HLE and neighbourhood characteristics. Attending a school judged to be 'outstanding' by Ofsted provides a moderately large boost to student attainment outcomes in all three core areas of the curriculum.

Moreover, the results point to the importance of the students' own perceptions and their views. Students' views of some school processes predicted differences in attainment and progress. Focussing on improving areas of the secondary school experience such as 'emphasis on learning' and the school's 'behaviour climate' for all three core subjects plus good 'learning resources' (for maths and science) is likely to promote better academic results and improved social-behavioural development (Sammons et al., 2011a, Sammons et al., 2011b show these factors predict better social-behavioural outcomes and dispositions[6]). This suggests that consulting students and obtaining their views is likely to be extremely helpful for school self-evaluation.

These results indicate that optimising each phase of education, pre-, primary and secondary school has the potential to improve the attainment of the whole school population in the longer term. These findings build on and extend findings reported for the EPPSE students at younger ages and show that better pre-schools and primary schools continue to have a protective effect in terms of boosting later attainment for all students.

Parenting is important too, and improving the early Years home learning environment (HLE) is likely to benefit the educational attainment of children in both the short term and the whole population in the longer term since such effects are shown to last into adolescence. All of these points are particularly relevant for young people growing up in disadvantaged families and neighbourhood contexts.

[6] 'Dispositions' here refer to factors such as academic self-concepts, enjoyment of school and citizenship values etc.

By 2050, the working age population within Europe will decrease by approximately 12 per cent, whereas the elderly will increase by 50 per cent. In these circumstances, maximising the productivity of the working population is necessary for economic sustainability. One strategy to increase productivity is to enhance educational attainment across the population. This is especially important when the skills necessary for modern economies are rising and changing in nature and when there is still great inequality of opportunity and outcomes. The results of this study provide some pointers to strategies that may help to address these issues in the medium to longer term.

Introduction

EPPSE 3-14 is a large-scale, longitudinal study funded by the Department for Education (DfE), originally designed to investigate the types of early childhood provision that are the most 'effective' in promoting young children's development during pre-school. This project was then continued and followed the EPPE sample into primary and later into secondary school. The aims were to explore whether any pre-school effects persist later in primary and secondary school, but also to examine primary and secondary school influences on development and outcomes.

Initially the project tracked children from pre-school, or, for the home group, at the start of primary school, to the end of Key Stage 1 (KS1) of primary school (age 7 plus years). Measures of the quality of 141 pre-school centres were recorded from five regions across England. The centres were representative of six types of provision: nursery classes, playgroups, local authority day nurseries, private day nurseries, nursery schools and integrated centres [i.e. combined centres that integrate education and care] (see Sammons et al., 2002; 2003). Results of analyses of children's outcomes in KS1 were reported by Sammons et al., 2004b and 2004c.

An extension to the original EPPE pre-school study has tracked the same children's development to the end of KS2 (age 11) (Sammons et al., 2007a; 2007b; 2008a; 2008b[7]; Sylva et al., 2010). This second phase was designed to explore continuing pre-school influences as well as to investigate the effects of primary school. EPPE 3-11 was the first study of pre-schools in Europe to adopt an educational effectiveness design based on sampling children in a range of different pre-school settings (centres) and used statistical approaches (multilevel modelling) that enable the identification of individual pre-school centre effects and to investigate the impact of pre-school and later school influences over different phases of education.

The current report focuses on pupils' cognitive attainment and progress in KS3 using Teacher Assessments (TA), measures of cognitive attainment in English, mathematics and science in Year 9 (age 14) and National Assessment test scores, measures of prior attainment taken in Year 6 (age 11+). In Year 9, variations in pupils' outcomes measured by TA levels were studied rather than aged standardised test scores as the KS3 National Assessment test data were not available for 2 of the 4 cohorts of students in the sample (due to a change in government policy)[8]. The TA levels data were available for approximately N=2643 (94%) and test scores were available for approximately N=1213 (43%) of the 'active' sample (N=2812).

Following the practice in previous phases of the project, the EPPSE 3-14 study continues to use a mixed methods approach (combining qualitative and quantitative methods) and an educational effectiveness design, including detailed statistical analyses of effectiveness and in-depth case studies of individual pupils and families (Sammons et al., 2005; Siraj-Blatchford et al., 2006; Sylva et al., 2010).

This report presents the results of analyses related to the influence of pre-school, primary and secondary school on pupils' cognitive attainments at the end of Year 9 and on their progress across KS3 from the end of Year 6 of primary school to the end of Year 9 in secondary school. Further analyses of pupils' social-behavioural development and attitudes to school in Year 9 will be reported in separate research reports (Sammons et al., 2011a, 2011b).

Aims

The aims of the research were to:

[7] Full details of the original EPPE study are provided in a series of Technical Papers (see Appendix 1).
[8] The KS3 National tests were abolished in October 2009.

- Investigate the associations between pupils' cognitive attainment in KS3 (Year 9, age 14) and background individual pupil, family and home learning environment (HLE) characteristics.
- Model pupils' current cognitive *attainment* in Year 9, and their *progress* over KS3.
- Explore the influence of pre-school experience, particularly in terms of attendance, quality and academic effectiveness on later cognitive outcomes.
- Examine the combined impact of the Home Learning Environment (HLE) and pre-school characteristics.
- Investigate the influence of primary school academic effectiveness on cognitive attainment and progress, when individual pupil, family and home learning environment (HLE) characteristics have been taken into account.
- Investigate the combined effect of pre-school and primary school experience on cognitive attainment.
- Assess whether the impact of pre- and primary school differs for more and less disadvantaged children.
- Investigate the influence of secondary school academic effectiveness and quality on cognitive attainment, when individual pupil, family and home learning environment (HLE) characteristics have been taken into account.
- Investigate the combined effect of secondary school experience with pre- and primary school experiences on cognitive attainment.
- Explore the effects of pupils self perception and views of schools on cognitive attainment.

Multiple Imputation

Due to policy changes on the use of KS3 National Assessment tests, the EPPSE sample was left without KS3 test scores for two of four cohorts. Therefore, the present report uses the Teacher Assessments (TA) on English, mathematics and science as cognitive outcomes for the KS3 National Assessments, as these were available for all 4 cohorts of the study. It is acknowledged that TA levels are less finely differentiated than test scores and this has implications for the analysis.

Major longitudinal studies have been widely advocating the use of multiple imputation as a strategy to successfully deal with missing data. Multiple imputation of missing data has been adopted in this study to provide a valuable tool for dealing with missing data and maximize sample size. Multiple imputation is the statistical procedure that replaces the missing values with a set of predicted values (Little & Rubin, 1987). This procedure generates several imputed data sets, which are then analysed and the results combined according to Rubin's rule (Rubin, 1987). Two alternative multiple imputation techniques have been tested: the ICE user-written program available in STATA and AMELIA II available in R. Comparisons between results from non-imputed and imputed data have been conducted and presented simultaneously. It was deemed appropriate to impute data for students who had cognitive outcomes for three or more time points (considering from Baseline until Year 9). Therefore, the original sample (N=3172) was reduced to N=3002.

Analyses Strategy

The analyses employ a range of statistical techniques from simple descriptive and correlation analysis to multilevel (hierarchical) modelling to examine the influences on pupils' cognitive attainment and progress. This paper focuses on TA levels in English, mathematics and science as measures of cognitive attainment in Year 9 and age standardised National Assessment data at the end of Year 6 in English and mathematics as measured of prior attainment in studying progress across KS3. In addition, exploratory and confirmatory factor analysis has been used to identify

underlying dimensions of KS2 HLE, school processes and affective outcomes such as academic self-concept or enjoyment of school.

Multilevel (hierarchical) regression was used to study the influence of various individual pupil, family, home learning environment (HLE) and neighbourhood factors as predictors of variation in pupils' Year 9 outcomes in the three core curriculum subjects. Additionally, the same analysis techniques were used to explore the pre-school, primary and secondary school influences on later cognitive attainment and progress during KS3. Earlier analyses enabled the calculation of value added estimates (residuals) of individual pre-school centre effects for the EPPSE 3-14 pupils who had attended a pre-school centre (see Sammons et al., 2002 for details). These value added measures of centre effectiveness have been included in subsequent analyses of pupils' educational outcomes in Year 9 of secondary school, to establish whether the effectiveness of the pre-school attended continues to show an impact on later cognitive attainment.

To examine the impact of primary school, measures of primary school academic effectiveness in English, mathematics and science have been derived from independent value added analyses of pupil progress for three successive full cohorts of children in English primary schools (2002-2004) using National assessment data sets matched between KS1 and KS2 over three years (see Melhuish et al., 2006a; 2006b). The impact of secondary school was explored using DfE indicators KS2-KS4 contextualised value added (CVA) measures and various Ofsted inspection judgements.

In addition, value added analyses of pupils' developmental progress were conducted to explore change over time in pupils' outcomes from Year 6 (end of KS2, age 11) to Year 9 (in KS3, age 14).

Structure of Report and Analyses

This report is divided into six sections. The first section provides background information concerning the characteristics of the EPPSE 3-14 sample and investigates whether particular groups of pupils show differences in their cognitive attainment in secondary school education. The attainment differences reported in Section 1.3.3 are 'raw' univariate attainment differences, whereas the effects reported in later sections are calculated 'net' of the influence of other predictors effects.

Section two examines the extent to which different individual pupil, family and home learning environment (HLE) background characteristics account for variations in pupils' English, mathematics and science outcomes. The 'net' influence of different background factors on pupils' attainments is explored. These analyses identify the unique (net) contribution of particular characteristics to variation in pupils' cognitive outcomes, while other influences are controlled. Thus, for example, the influence of family Socio-Economic Status (SES) is established while taking into account the influence of parents' qualification levels, income, ethnicity, birth weight, HLE etc. Results are reported in effect sizes (ES), a statistical measure of the relative strength of different predictors. In addition, estimates shown in Tables illustrate differences in terms of TA levels. It is of policy interest to establish the nature and strength of such background influences individually and collectively, as they are relevant to issues of equity and social inclusion.

The third section explores the continued influence of pre-school, primary and secondary school experience on pupils' cognitive outcomes at the end of Year 9. In the first phase of the earlier EPPE research it was shown that pre-school experience gave children a better start to primary school in terms of higher cognitive attainment and improved social-behavioural outcomes. Lack of pre-school experience, particularly for more vulnerable groups of young children, was found to be a further disadvantage (Sammons et al., 2002; 2003). The effect of pre-school attendance was, in these earlier analyses, supplemented with measures of pre-school centre influence, namely the observed quality of pre-school provision (measured by the ECERS-R and ECERS-E scales) and pre-school centre effectiveness (measured by value added residual estimates based on cognitive progress during the pre-school period). The same children's measurements proved to be

significant predictors of later cognitive attainment for the EPPSE sample measured at the end of primary school. Therefore, in this report we explore the potential lasting effects of attending pre-school on the cognitive attainment during secondary school as well. This section also addresses the question of differential pre-school effects for different groups of pupils, e.g., those from disadvantaged backgrounds. Similarly, the predictive influence of measures of primary school academic effectiveness[9] on pupils' later cognitive outcomes in Year 9 was also explored. In addition, the analyses establish whether certain groups of pupils are more sensitive to the academic effectiveness of the primary school they attended than other pupils. Additional analyses explored the combined impact of different characteristics of pre-school experience (quality and effectiveness) and primary school academic effectiveness. The predictive influences of measures of secondary school academic effectiveness[10] and quality measured by Ofsted inspection judgments were also studied. Additional analyses explored the combined impact of different characteristics of secondary school academic effectiveness with pre-school experience (quality and effectiveness) and primary school academic effectiveness.

Section four presents results of analyses that explored pupils' academic progress from the end of Year 6 at primary school to Year 9 in secondary school. Value added multilevel analyses of EPPSE 3-14 pupils' cognitive progress across KS3 have been conducted; these analyses control for prior attainment (at the end of Year 6) in analysing progress over time. They are used to complement the contextualised models of attainment to establish how far background factors and educational measures of pre- and primary schools also predict progress across KS3.

Section five shows the results of the analyses that examined the predictive influences of school and teaching processes as well as the influences of pupils' self-views on the various measures of secondary cognitive outcomes in Year 9.

The final section summarises the results drawing together the main findings, conclusions and implications for policy and practice.

[9] These were value added academic effectiveness measures for primary schools that were calculated independently using National Assessment data for all primary schools in England linking KS1 and KS2 results) (Melhuish et al., 2006a; 2006b).

[10] These were KS2-KS4 CVA academic effectiveness measures for secondary schools provided by DfE.

1. Characteristics of the Sample at the End of Year 9

The present study relies on the original EPPE sample. The original sampling procedure is described fully in the EPPE Technical Paper 1 (Sylva et al., 1999). Briefly, six English Local Authorities (LAs) in five regions were selected to participate in the research with pupils drawn from six main types of pre-school provision: nursery classes, playgroups, private day nurseries, Local Authority (LA) day nurseries, nursery schools and integrated (i.e., combined centres that integrate education and care) centres. In order to enable comparison of centre and type of provision effects the project was designed to recruit approximately 500 pupils, 20 in each of 20-25 centres, from the various types of provision. In some LAs certain forms of provision were less common and other forms more typical. Within each LA, centres of each type were selected by stratified random sampling and, due to the small size of some centres in the project (i.e. rural playgroups) more of these centres were sampled than originally proposed, bringing the centre sample total to 141 centres. In all 2,857 pupils in the pre-school sample were tracked to entry to reception class. An additional sample of 315 'home' pupils (those who had not attended a pre-school centre) was recruited at entry to primary school, for comparison with those who had attended a pre-school centre, bringing the total sample to 3,172.

Since the start of the study 14 years ago, the EPPE pupils have been assessed on their cognitive and social-behavioural development at various time points. This report refers to two time points at which pupils completed cognitive assessments: at the end of Year 6 (age 11) and at the end of Year 9 (age 14).

On 24 October 2008 there was an announcement by the Secretary of State that the current testing regime for KS3 would cease. Although Teacher Assessment (TA) levels would still be a requirement there was no statutory obligation on schools to conduct National Assessment test scores. This posed a challenge for the EPPSE project, as two of the four cohorts from the EPPSE sample were left without results for the KS3 National Assessment test scores. Thus, the present report uses mainly the TA levels in English, mathematics and science as cognitive outcomes and not the results of the KS3 National Assessment test scores (although descriptive statistics with these cognitive outcomes are included in Appendix 3). Furthermore, multiple imputation was used to overcome the missing data in both TA and test scores.

To make the imputation model more robust, we started with the original sample (N=3172) and selected only the cases that had cognitive outcomes for three or more time points (considering from Baseline until Year 9). For Year 9, having either a test score or a TA was considered a valid data point. Cases were included only if they satisfied this criterion simultaneously for both English and mathematics (thus, for example if a pupil had the 3 valid points for mathematics but not for English, this pupil was not included in the final sample). Moreover, an additional requirement was imposed over the sample size: cases were included only if they did not have missing data on more than five background variables (e.g., family SES, health problems, salary). The final sample size included N=3002 pupils (see more details on multiple imputation in Appendix 10).

This section provides descriptive statistics for the sample at the end of Year 9. Details of the main findings of the analyses conducted on pupils' attainment and progress up to the end of KS2 (Year 6) can be found in Sammons et al. (2008a).

1.1. Original Data

Table 1.1 and Table 1.2 provide a brief summary of the characteristics of the EPPSE 3-14 sample for which we have valid cognitive outcomes (TA) at the end of Year 9 (see Tables on test scores in Appendix 2). Very similar proportion of adolescents had valid data on English, mathematics and science TA levels ($N_{English}$=2574; $N_{mathematics}$=2574; $N_{science}$=2575). As a result, the distributions of these pupils within different demographic characteristics were also very similar.

In terms of gender distribution, 51% (almost 52% of those with valid mathematics TA) were males and 49% per cent females (48% of those with valid mathematics TA). The majority of the adolescents (74%) were of White UK heritage, while Bangladeshi young people represented the smallest ethnic group (1%).

Regarding family structure, 17% of the young people lived in large families (having 3 or more siblings) while more than half of the sample had one or two siblings (64%). Table 1.1 also shows the distribution of the Early Years Home Learning Environment (HLE) index which is a combined measure of aspects of the quality of the home learning environment in the early years (see Appendix 5 and Melhuish et al., 2008a; Sammons et al., 2002; 2003; 2004). A number of measures collected at entry to the study from the parent interview provided an indication of aspects of the HLE in the early years. These are based on the frequency of engagement in specific activities involving the child such as, teaching the alphabet, reading to the child, listening to the child read, taking the child to the library etc. (as reported by the parents at interview). Over 40% of the adolescents belonged to families where a good or very good home learning environment in the Early years was present. A very poor HLE characterised around 10% of the sample. In the present sample, 13% of the adolescents had not attended any type of pre-school (the ‘home’ group) before entering primary school.

Table 1.1: Selected Characteristics of Sample with Valid Cognitive Data in Year 9 - Original Data

	Year 9 English TA N=2574		Year 9 Mathematics TA N=2574		Year 9 Science TA N=2575	
	N	%	N	%	N	%
Gender						
Male	1311	50.9	1306	51.9	1312	51.0
Female	1263	49.1	1268	48.1	1263	49.0
Ethnicity						
White European Heritage	85	3.3	85	3.3	83	3.2
Black Caribbean Heritage	101	3.9	100	3.9	101	3.9
Black African Heritage	53	2.1	54	2.1	54	2.1
Any Other Ethnic Minority Heritage	59	2.3	59	2.3	59	2.3
Indian Heritage	58	2.3	58	2.3	58	2.3
Pakistani Heritage	132	5.1	125	4.9	134	5.2
Bangladeshi Heritage	25	1.0	25	1.0	25	1.0
Mixed Heritage	149	5.8	151	5.9	149	5.8
White UK Heritage	1911	74.3	1916	74.5	1911	74.2
Number of Siblings in the House (age3/5)						
No siblings	514	20.2	513	19.7	514	20.2
1 - 2 siblings	1618	63.7	1619	63.6	1617	63.6
3+ siblings	409	16.1	409	16.8	411	16.2
Early Years Home Learning Environment (HLE) Index						
<13	238	9.6	235	10.3	238	9.5
14-19	576	23.1	576	25.0	579	23.2
20-24	621	24.9	623	23.4	622	24.9
25-32	779	31.3	783	29.7	777	31.2
>33	278	11.2	276	11.6	277	11.1
Type of Pre-School						
Nursery class	515	20.0	518	40.7	518	20.1
Playgroup	531	20.6	532	17.0	530	20.6
Private day nursery	356	13.8	357	11.6	353	13.7
Local Authority day nursery	338	13.1	336	15.6	340	13.2
Nursery schools	440	17.1	440	1.9	439	17.0
Integrated (Combined) centres	145	5.6	145	.1	145	5.6
Home	249	9.7	246	13.1	250	9.7

In terms of parents' qualification, almost 13% of mothers and fathers had a degree or a higher degree. With respect to the family's social economic status[11] (SES), more than 30% were classified in the professional category. A higher percentage (50%) were classified as skilled (either manual or non manual) and only 2.9% were unemployed. Nearly 20% of the pupils were eligible or receiving free school meals (FSM) in Year 9[12]. Almost half of the sample (46%) lived in families with very low (below £17,500) or no income. Seventy- eight percent did not have any SEN provision, while only 3% had a full SEN statement.

[11] Family SES was calculated by considering the highest SES status of the mother or the father.

[12] The FSM information collected with the EPPSE Year 9 Pupil Profile Questionnaire had a high percentage of missing values (46%). Therefore, this information was combined with the FSM information available from the National Pupil Database. Additionally, it is important to stress that the EPPSE variable represents the students who actually receives FSM, while the NPD variable indicates the pupils who are eligible to receive FSM. NPD 's definition of the FSM eligibility: *"Pupils should be recorded as eligible (true) only if a claim for free school meals has been made by them or on their behalf by parents and either (a) the relevant authority has confirmed their eligibility and a free school meal is currently being provided for them, or (b) the school or the LEA have seen the necessary documentation (for example, an Income Support order book) that supports their eligibility, and the administration of the free meal is to follow as a matter of process. Conversely, if pupils are in receipt of a free meal but there is confirmation that they are no longer eligible and entitlement will be revoked, false should be applied."*

Table 1.2: Selected Characteristics of Sample with Valid Cognitive Data in Year 9 - Original Data

	Year 9 English TA N=2574		Year 9 Mathematics TA N=2574		Year 9 Science TA N=2575	
	N	**%**	**N**	**%**	**N**	**%**
Mother's Qualification						
None	559	22.3	558	22.3	561	22.4
Vocational	386	15.4	385	15.4	386	15.4
16 Academic	1002	40.0	1004	40.1	1001	40.0
18 Academic	197	7.9	197	7.9	197	7.9
Degree or Higher degree	323	12.9	323	12.9	322	12.9
Other professional	37	1.5	38	1.5	38	1.5
Father's Qualification						
None	430	16.9	429	16.9	433	17.0
Vocational	308	12.1	307	12.1	306	12.0
16 academic	623	24.5	624	24.6	623	24.5
18 academic	179	7.1	178	7.0	179	7.0
Degree or Higher degree	333	13.1	337	13.3	334	13.1
Other professional	29	1.1	29	1.1	29	1.1
Absent Father	637	25.1	635	25.0	636	25.0
Family Highest SES (age3/5)						
Professional Non Manual	165	6.5	167	6.6	163	6.4
Other Professional Non manual	605	23.9	605	23.9	606	23.9
Skilled Non Manual	876	34.6	879	34.7	874	34.5
Skilled Manual	398	15.7	395	15.6	400	15.8
Semi-Skilled	349	13.8	348	13.7	349	13.8
Unskilled	68	2.7	68	2.7	69	2.7
Unemployed / Not working	73	2.9	72	2.8	74	2.9
FSM at Year 9						
No Free School Meals (FSM) (at Year 9)	2041	80.2	2040	80.2	2044	80.3
Free School Meals (FSM) (at Year 9)	504	19.8	504	19.8	503	19.7
Family Earned Income at KS1						
No salary	488	24.2	485	24.1	488	24.2
£ 2,500 – 17,499	442	21.9	440	21.8	442	21.9
£ 17,500 – 29,999	375	18.6	375	18.6	376	18.7
£ 30,000 – 37,499	245	12.2	246	12.2	245	12.2
£ 37,500 – 67,499	375	18.6	379	18.8	374	18.6
£ 67,500 – 132,000+	90	4.5	90	4.5	90	4.5
SEN Status at Year 9						
No Special Provision	1976	78.4	1973	78.3	1976	78.3
School Action	299	11.9	299	11.9	300	11.9
School Action Plus	163	6.5	168	6.7	165	6.5
Statement of SEN	84	3.3	81	3.2	83	3.3

Table 1.3 and Table 1.4 present the same demographic characteristics for the pupils who had missing data on the cognitive outcomes measured as TA levels. Males were slightly over represented in the missing TA data group. Those with missing TA data were significantly more likely to have parents who were highly qualified (degree or higher degree) or be of high family SES (Professional non-manual).

Table 1.3: Selected Characteristics of Sample with Missing Cognitive Data in Year 9 - Original Data

	Missing Year 9 English TA N=428		Missing Year 9 Mathematics TA N=428		Missing Year 9 Science TA N=427	
	N	%	N	%	N	%
Gender						
Male	232	54.2	237	55.4	231	54.1
Female	196	45.8	191	44.6	196	45.9
Ethnicity						
White European Heritage	25	5.9	25	5.9	27	6.3
Black Caribbean Heritage	8	1.9	9	2.1	8	1.9
Black African Heritage	8	1.9	7	1.6	7	1.6
Any Other Ethnic Minority Heritage	19	4.4	19	4.4	19	4.5
Indian Heritage	6	1.4	6	1.4	6	1.4
Pakistani Heritage	28	6.6	35	8.2	26	6.1
Bangladeshi Heritage	6	1.4	6	1.4	6	1.4
Mixed Heritage	32	7.5	30	7.0	32	7.5
White UK Heritage	295	69.1	290	67.9	295	69.2
Number of Siblings in the House (age3/5)						
No siblings	86	20.4	87	20.7	86	20.5
1 - 2 siblings	278	66.0	277	65.8	279	66.4
3+ siblings	57	13.5	57	13.5	55	13.1
Early Years Home Learning Environment (HLE) Index						
<13	45	10.9	48	11.6	45	10.9
14-19	69	16.7	69	16.7	66	16.0
20-24	85	20.5	83	20.1	84	20.3
25-32	155	37.4	151	36.6	157	38.0
>33	60	14.5	62	15.0	61	14.8
Type of Pre-School						
Nursery class	65	15.2	62	14.5	62	14.5
Playgroup	56	13.1	55	12.9	57	13.3
Private day nursery	132	30.8	131	30.6	135	31.6
Local Authority day nursery	63	14.7	65	15.2	61	14.3
Nursery school	55	12.9	55	12.9	56	13.1
Integrated (Combined) centres	25	5.8	25	5.8	25	5.9
Home	32	7.5	35	8.2	31	7.3

Those with missing data were also more likely to be from the high income group (as reported earlier in KS1). The different social characteristics of those with missing TA data are likely to reflect attendance at private (fee paying schools) where national curriculum assessments are rarely used in Year 9.

Table 1.4: Selected Characteristics of Sample with Missing Cognitive Data in Year 9 - Original Data

	Missing Year 9 English TA N=428		Missing Year 9 Mathematics TA N=428		Missing Year 9 Science TA N=427	
	N	%	N	%	N	%
Mother's Qualification						
None	67	16.0	68	16.3	65	15.6
Vocational	48	11.5	49	11.7	48	11.5
16 Academic	91	21.7	89	21.3	92	22.0
18 Academic	45	10.7	45	10.8	45	10.8
Degree or Higher degree	161	38.4	161	38.5	162	38.8
Other professional	7	1.7	6	1.4	6	1.4
Father's Qualification						
None	47	11.1	48	11.4	44	10.5
Vocational	29	6.9	30	7.1	31	7.4
16 academic	45	10.7	44	10.4	45	10.7
18 academic	36	8.5	37	8.8	36	8.6
Degree or Higher degree	175	41.5	171	40.5	174	41.3
Other professional	3	.7	3	.7	3	.7
Absent Father	87	20.6	89	21.1	88	20.9
Family Highest SES (age3/5)						
Professional Non Manual	99	23.5	97	23.0	101	24.0
Other Professional Non manual	144	34.1	144	34.1	143	34.0
Skilled Non Manual	77	18.2	74	17.5	79	18.8
Skilled Manual	44	10.4	47	11.1	42	10.0
Semi-Skilled	41	9.7	42	10.0	41	9.7
Unskilled	6	1.4	6	1.4	5	1.2
Unemployed / Not working	11	2.6	12	2.8	10	2.4
FSM at Year 9						
No Free School Meals (FSM) (at Year 9)	226	88.3	227	88.3	223	87.8
Free School Meals (FSM) (at Year 9)	30	11.7	30	11.7	31	12.2
Family Earned Income at KS1						
No salary	77	22.1	80	22.9	77	22.1
£ 2,500 – 17,499	38	10.9	40	11.5	38	10.9
£ 17,500 – 29,999	35	10.0	35	10.0	34	9.7
£ 30,000 – 37,499	26	7.4	25	7.2	26	7.4
£ 37,500 – 67,499	93	26.6	89	25.5	94	26.9
£ 67,500 – 132,000+	80	22.9	80	22.9	80	22.9
SEN Status at Year 9						
No Special Provision	185	75.8	188	76.7	185	76.4
School Action	22	9.0	22	9.0	21	8.7
School Action Plus	24	9.8	19	7.8	22	9.1
Statement of SEN	13	5.3	16	6.5	14	5.8

1.2. Imputed Data

Table 1.5 and Table 1.6 compare the distribution of the original and imputed characteristics of the EPPSE 3-14 sample at the end of Year 9. Some of the demographic variables did not require imputation as we had the information for the full sample (i.e., gender, type of pre-school attended). However, we had missing values on ethnicity for 2 cases and these were not imputed. The distributions of the imputed background characteristics are similar to the original distributions.

Table 1.5: Selected Characteristics of Pupils in Year 9 - Original and Imputed Data (N = 3002)

	Year 9 Original Sample N=3002		Year 9 Pooled Imputed Sample N=3002	
	N	%	N	%
Gender				
Male	1543	51.4	1543	51.4
Female	1459	48.6	1459	48.6
Ethnicity				
White UK Heritage	2206	73.5	2206	73.5
White European Heritage	110	3.7	110	3.7
Black Caribbean Heritage	109	3.6	109	3.6
Black African Heritage	61	2.0	61	2.0
Indian Heritage	64	2.1	64	2.1
Pakistani Heritage	160	5.3	160	5.3
Bangladeshi Heritage	31	1.0	31	1.0
Mixed Heritage	181	6.0	181	6.0
Any Other Ethnic Minority Heritage	78	2.6	78	2.6
Missing	*2*	*0.1*	*2*	*0.1*
Number of Siblings in the House (age3/5)				
No siblings	600	20.0	608	20.3
1 - 2 siblings	1896	63.2	1920	64.0
3+ siblings	466	15.5	474	15.8
Missing	*40*	*1.3*		
Early Years Home Learning Environment (HLE) Index				
<13	283	9.4	294	9.7
14-19	645	21.5	665	22.1
20-24	706	23.5	732	24.4
25-32	934	31.1	965	32.1
>33	338	11.3	347	11.5
Missing	*96*	*3.2*		
Type of Pre-School				
Nursery class	580	19.3	580	19.3
Playgroup	587	19.6	587	19.6
Private day nursery	488	16.3	488	16.3
Local Authority day nursery	401	13.4	401	13.4
Nursery schools	495	16.5	495	16.5
Integrated (Combined) centres	170	5.7	170	5.7
Home	281	9.4	281	9.4

Table 1.6: Selected Characteristics of Pupils in Year 9 - Original and Imputed Data (N = 3002)

	Year 9 Original Sample N=3002		Year 9 Pooled Imputed Sample N=3002	
	N	**%**	**N**	**%**
Mother's Qualification				
None	626	20.9	651	21.7
Vocational	434	14.5	448	14.9
16 Academic	1093	36.4	1120	37.3
18 Academic	242	8.1	247	8.2
Degree or Higher degree	484	16.1	492	16.4
Other professional	44	1.5	44	1.5
Missing	*79*	*2.6*		
Father's Qualification				
None	477	15.9	786	26.2
Vocational	337	11.2	470	15.7
16 academic	668	22.3	856	28.5
18 academic	215	7.2	268	8.9
Degree or Higher degree	508	16.9	586	19.5
Other professional	32	1.1	36	1.2
Absent Father	724	24.1		
Missing	*41*	*1.4*		
Family Highest SES (age3/5)				
Professional Non Manual	264	8.8	266	8.8
Other Professional Non manual	749	25.0	756	25.2
Skilled Non Manual	953	31.7	967	32.2
Skilled Manual	442	14.7	450	15.0
Semi-Skilled	390	13.0	400	13.3
Unskilled	74	2.5	76	2.5
Unemployed / Not working	84	2.8	87	2.9
Missing	*46*	*1.5*		
FSM at Year 9				
No Free School Meals (FSM) (at Year 9)	2267	75.5	2431	81.0
Free School Meals (FSM) (at Year 9)	534	17.8	571	19.0
Missing	*201*	*6.7*		
Family Earned Income at KS1				
No salary	565	18.8	788	26.3
£ 2,500 – 17,499	480	16.0	615	20.5
£ 17,500 – 29,999	410	13.7	511	17.0
£ 30,000 – 37,499	271	9.0	328	10.9
£ 37,500 – 67,499	468	15.6	565	18.8
£ 67,500 – 132,000+	170	5.7	195	6.5
Missing	*638*	*21.3*		
SEN Status at Year 9				
No Special Provision	2161	72.0	2346	78.2
School Action	321	10.7	348	11.6
School Action Plus	187	6.2	204	6.8
Statement of SEN	97	3.2	105	3.5
Missing	*236*	*7.9*		

1.3. Cognitive assessments

To take account of development and age, the study uses different assessment instruments for cognitive outcomes at different time points:

- *Year 6:* National Assessment at KS2: English and mathematics (all 4 cohorts)
- *Year 9:* Teacher Assessment at KS3: English, mathematics and science (all 4 cohorts)
- *Year 9:* National Assessment at KS3: English and mathematics (Cohort 1 and 2)[13]

TA levels were obtained from the National Pupil Dataset (NPD) at the end of Year 9 or directly from the schools when these were missing. TA levels are less differentiated measures of attainment compared to tests as the levels are only ordinal categories placing pupils into a few ranked attainment groups. In Year 9, pupils were awarded TA levels from level 1 to level 8 and the same levels applied to English, mathematics and science.

National Assessment data were collected for the sample at the end of Year 6 and Year 9. Similarly to the TA levels, test levels were also ordinal categories. In Year 6, the pupils were classified in 6 groups from working towards level 1, level 1 through to level 6. However in Year 9, the levels of the National Assessments were awarded differently for English and mathematics. For English, pupils were categorised in 6 groups from working towards level 3 up to level 7. For mathematics, pupils were classified in 5 groups, although further categorised based on the type of tiers. For example, the levels for Tier 3-5 went from 1 through 5, while for Tier 6-8, levels went from 4 to 8.

In addition to test levels, data were also collected on pupils' individual test scores within levels. This allowed the creation of more finely differentiated outcome measures (which are referred to as decimalised levels) for the multilevel analysis.

For pupils who scored high enough to attain a valid level for the National Assessment test taken, their decimalised score was calculated as follows:

$$DecimalisedLevel = LevelAchieved + \frac{RawScore - LowestValidScoreForThatLevel}{LowestValidScoreForHigherLevel - LowestValidScoreForThatLevel}$$

Furthermore, to ensure comparability over time, an internal age standardisation and normalisation procedure was applied to the decimalised data. This procedure takes account of age effects within one school year: hence age of pupil does not feature as a significant predictor of attainment / progress although it was included in the models. The scores presented in this paper are internally standardised to a mean of 100 and a standard deviation of 15. Therefore, all pupils scoring better than 100 at a certain time point are scoring at or above the attainment level expected for their chronological age (belong to the upper half of the sample of that assessment, controlling for age effects). Due to the use of internally standardised attainment scores, the scores can only be used to investigate the progress or improvement of certain groups of pupils *relative* to the total EPPSE 3-14 sample, but cannot be used to show *absolute* progress over time.

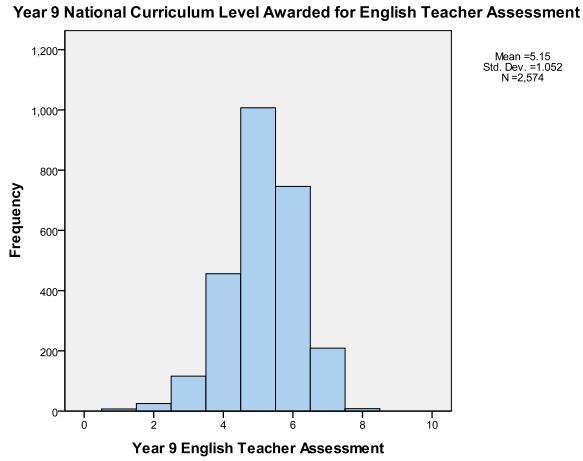
1.3.1. Descriptive Statistics of Cognitive Outcomes (Original versus Imputed Data)

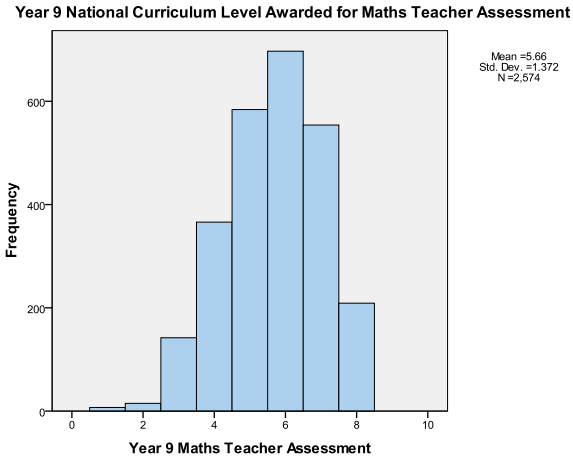
Figure 1.1 presents the distribution of TA levels in English, mathematics and science (see Appendix 3 for similar distributions for National Assessment results). Table 1.8 and Table 1.9 show the basic descriptive statistics for the outcomes considered on the original data and the multiple imputation data. The descriptive statistics are very similar in terms of means and standard

[13] Due to the very high proportion of missing data on the National Assessment test scores, this report focuses on the TA levels. However, analyses were also conducted on the original and imputed test scores.

deviations, but there is a slight increase in both the means and the standard deviations on the multiple imputed data sets.

Figure 1.1: Distributions of Different Measures of Cognitive Attainment at Year 9 – Original Data





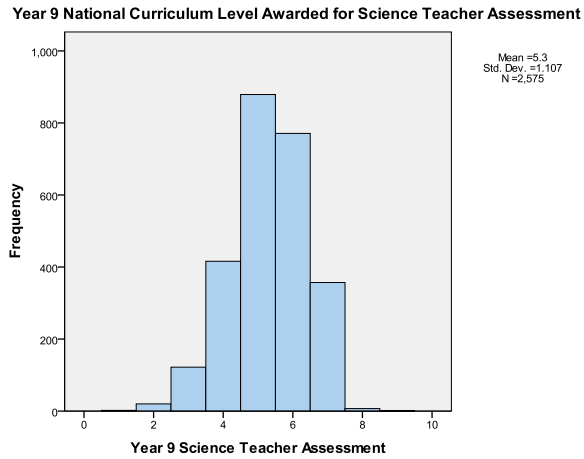


Table 1.7: Distributions of Different Measures of Cognitive Attainment at Year 9 – Original Data

	Year 9 English TA		Year 9 Mathematics TA		Year 9 Science TA	
National Curriculum Level Awarded	N	%	N	%	N	%
1	7	.3	7	.3	2	.1
2	25	1.0	15	.6	20	.8
3	116	4.5	142	5.5	122	4.7
4	456	17.7	366	14.2	416	16.2
5	1007	39.1	584	22.7	879	34.1
6	746	29.0	697	27.1	772	30.0
7	209	8.1	554	21.5	357	13.9
8	8	.3	209	8.1	7	.3

	Year 9 English TA		Year 9 Mathematics TA		Year 9 Science TA	
National Curriculum Level Awarded	N	%	N	%	N	%
1	7	.3	7	.3	2	.1
2	25	1.0	15	.6	20	.8
3	116	4.5	142	5.5	122	4.7
4	456	17.7	366	14.2	416	16.2
5	1007	39.1	584	22.7	879	34.1
6	746	29.0	697	27.1	772	30.0
7	209	8.1	554	21.5	357	13.9
8	8	.3	209	8.1	7	.3
Total	**2574**	**100.0**	**2574**	**100.0**	**2575**	**100.0**

Table 1.8: Descriptive Statistics of Cognitive Outcomes at Year 9 – Original Data

	N	Min	Max	Mean	Std. Dev.
Year 9 English Teacher Assessment	2574	1	8	5.15	1.05
Year 9 Mathematics Teacher Assessment	2574	1	8	5.66	1.37
Year 9 Science Teacher Assessment	2575	1	8	5.30	1.10
Total	3002				

Table 1.9: Descriptive Statistics of Cognitive Outcomes at Year 9 – Imputed Data

	N	Min	Max	Mean	Std. Dev.
Year 9 English Teacher Assessment	3002	1	8	5.18	1.06
Year 9 Mathematics Teacher Assessment	3002	1	8	5.70	1.38
Year 9 Science Teacher Assessment	3002	1	8	5.32	1.11
Total	3002				

1.3.2. Associations between Pupils' Attainment in Different Outcomes and Over Time

Correlations explore the associations between pupils' attainment on different outcomes and over time.[14] Pupils' attainment (English & mathematics) in Year 9 was strongly and positively correlated (r_{orig}=0.72; r_{imp}=0.65), indicating those who do well in English generally also do well in mathematics at the end of Year 9, while those who score poorly on one also tend to do poorly in the other. This correlation is higher than the equivalent correlation between English and mathematics scores at the end of Year 6 (r=0.66). Additionally, the relationships between test scores and TA levels in

[14] A correlation is a measure of statistical association that ranges from + 1 to -1.

Year 9 were very strong ($r_{English}$=0.75, $r_{mathematics}$=0.89) for the original data; however, slightly lower for the imputed data ($r_{English}$=0.66, $r_{mathematics}$=0.80).

The cognitive scores are not only highly associated with each other but also show moderate to high correlations with prior attainment (see Table 1.10, Table 1.11 and Table 1.12). A strong relationship was found for attainment in English in Year 9 and Year 6 (r_{orig}=0.74; r_{imp}=0.78), while attainment in mathematics was also strongly correlated between Year 9 and Year 6 (r_{orig}=0.86; r_{imp}=0.87).

Table 1.10: Correlations Between Pupils' Standardised Cognitive Outcomes (English and Mathematics) and Prior Attainment – Original Data

	Year 9 English	**Year 9 Mathematics**	**Year 9 English**	**Year 9 Mathematics**
	National Assessment Standardised Scores	National Assessment Standardised Scores	TA	TA
Year 9 English National Assessment Standardised Scores	1		0.75 (N=1105)	0.68 (N=1103)
Year 9 Mathematics National Assessment Standardised Scores	0.72 (N=1133)	1	0.70 (N=1143)	0.89 (N=1144)
Year 6 English National Assessment Standardised Scores	0.74 (N=1100)	0.66 (N=1125)	0.70 (N=2416)	0.65 (N=2413)
Year 6 Mathematics National Assessment Standardised Scores	0.60 (N= 1107)	0.86 (N=1135)	0.61 (N=2426)	0.82 (N=2424)

On the original data, we tested the correlations of Year 9 attainment in science (measured by both standardised test scores and TA levels) and Year 9 and Year 6 attainment in English and mathematics (Table 1.11). The results indicate that the attainment in science is related more strongly to attainment in mathematics than to attainment in English, regardless of how the science attainment was measured (standardised test score or TA levels). However, the correlations between standardised tests were higher than the correlations between TA levels and standardised test scores.

Table 1.11: Correlations Between Pupils' Standardised Cognitive Outcomes (Science, English and Mathematics) and Prior Attainment – Original Data

	Year 9 Science	**Year 9 Science**
	National Assessment Standardised Scores	TA
Year 9 English National Assessment Standardised Scores	0.77 (N=1133)	0.66 (N=1125)
Year 9 Mathematics National Assessment Standardised Scores	0.87 (N=1172)	0.79 (N=1146)
Year 9 Science National Assessment Standardised Scores	1	0.82 (N=1147)
Year 6 English National Assessment Standardised Scores	0.68 (N=1121)	0.64 (N=2417)
Year 6 Mathematics National Assessment Standardised Scores	0.73 (N= 1131)	0.68 (N=2427)

Table 1.12: Correlations Between Pupils' Standardised Cognitive Outcomes (English and Mathematics) and Prior Attainment – Imputed Data (N=3002)

	Year 9 English	Year 9 Mathematics	Year 9 English	Year 9 Mathematics
	National Assessment Standardised Scores	National Assessment Standardised Scores	TA	TA
Year 9 English National Assessment Standardised Scores	1		0.66	0.62
Year 9 Mathematics National Assessment Standardised Scores	0.65	1	0.63	0.80
Year 6 English National Assessment Standardised Scores	0.78	0.67	0.72	0.66
Year 6 Mathematics National Assessment Standardised Scores	0.63	0.87	0.63	0.81

At this stage, the high correlations between cognitive assessments at different time points indicate that the assessments are measuring similar aspects of attainment. The impact of earlier attainment as predictors for later attainment will be explored further in Section 4. Of particular interest will be the 'net' influence of different pupil, background and home learning environment (HLE) characteristics in Year 9, when controlling for prior attainment of the pupils, as this will indicate whether some groups make more or less progress relative to others during KS3.

1.3.3. Differences in Attainment for Different Groups of Pupils

This section presents figures on the differences in cognitive attainment in Year 9 measured by TA levels for pupil sub-groups of particular interest. Previous analyses reported significant differences in cognitive outcomes for different groups at various time points (e.g., pre-school, entry to primary school, at the end of Year 1, at the end of Year 2, at the end of Year 5 and at the end of Year 6) (Sammons et al., 2004b; 2004c; 2007a; 2008a). These particular pupil groups refer to individual pupil, family and Early Home Learning Environment (HLE) characteristics and were also used as predictors for different aspects of the pupils' social-behavioural development (see Sammons et al., 2011a).

The reported differences represent the 'raw' differences in the average results for different pupil sub-groups as there is no control for the influence of any other variables. This means, for example, if there are sizeable differences between individual ethnic groups, these differences could also be due, at least in part, to family SES or to language differences between the ethnic groups. Section 2 of this report provides more detailed statistical analyses of these patterns using multilevel models to explore the 'net' contribution of different factors and reports the relevant effect sizes, controlling for other factors. It will also address the issue of change in 'net' contribution of different factors over time in terms of effect sizes[15].

Gender

At younger ages females were found to score higher in cognitive attainment. At the end of KS3 (Year 9), this pattern of average results was found for the original TA levels in English, but not for the average results for TA levels in mathematics or science, where, as a group, females and males tend to have similar results, although the variation (shown by the *SD* is slightly higher for males) (see Table 1.13).

[15] Effect sizes (ES) are a statistical measure of the relative strength of different predictors.

Table 1.13: Cognitive Attainment in Year 9 by Gender – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	Gender	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	Male	5.0	1.1	1311	5.0	1.1	1543
	Female	5.4	1.0	1263	5.4	1.0	1459
Year 9 Mathematics Teacher Assessment	Male	5.7	1.4	1306	5.7	1.4	1543
	Female	5.7	1.3	1268	5.7	1.3	1459
Year 9 Science Teacher Assessment	Male	5.3	1.2	1312	5.3	1.2	1543
	Female	5.3	1.0	1263	5.4	1.1	1459

Ethnicity

Consistent with previous findings for the pupils at younger ages, Pakistani pupils continue to have at the end of Year 9 the lowest attainment levels in English and mathematics, but also in science (see Table 1.14). Pupils of Indian heritage have the highest average results in TA levels.

Table 1.14: Cognitive Attainment in Year 9 by Ethnic Groups - Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	Ethnicity	Mean	Std. Dev.	N	Mean	Std. Dev	N
Year 9 English Teacher Assessment	White European Heritage	5.1	1.2	85	5.1	1.2	110
	Black Caribbean Heritage	5.1	1.0	101	5.0	1.0	109
	Black African Heritage	5.3	1.0	53	5.3	1.0	61
	Any Other Ethnic Minority	5.1	.9	59	5.1	1.0	78
	Indian	5.3	1.2	58	5.3	1.1	64
	Pakistani	4.8	.9	132	4.8	0.9	160
	Bangladeshi	5.3	1.1	25	5.2	1.1	31
	Mixed Race	5.1	1.2	149	5.1	1.2	181
	White UK Heritage	5.2	1.0	1911	5.2	1.1	2206
Year 9 Mathematics Teacher Assessment	White European Heritage	5.5	1.5	85	5.6	1.5	110
	Black Caribbean Heritage	5.4	1.4	100	5.4	1.4	109
	Black African Heritage	5.5	1.4	54	5.6	1.4	61
	Any Other Ethnic Minority	5.8	1.3	59	5.7	1.3	78
	Indian	6.0	1.6	58	6.0	1.6	64
	Pakistani	5.2	1.3	125	5.2	1.3	160
	Bangladeshi	5.7	1.7	25	5.6	1.6	31
	Mixed Race	5.5	1.5	151	5.6	1.5	181
	White UK Heritage	5.7	1.3	1916	5.8	1.4	2206
Year 9 Science Teacher Assessment	White European Heritage	5.4	1.4	83	5.4	1.3	110
	Black Caribbean Heritage	5.0	1.0	101	5.0	1.0	109
	Black African Heritage	5.2	1.1	54	5.2	1.1	61
	Any Other Ethnic Minority	5.4	1.0	59	5.4	1.0	78
	Indian	5.5	1.4	58	5.5	1.4	64
	Pakistani	5.0	1.1	134	4.9	1.1	160
	Bangladeshi	5.4	1.1	25	5.3	1.1	31
	Mixed Race	5.2	1.2	149	5.2	1.2	181
	White UK Heritage	5.3	1.1	1911	5.4	1.1	2206

Parents' Qualification Level

Table 1.15 shows the attainment in English, mathematics and science by the mother's highest qualification level. This variable proved to be a strong predictor of pupils' cognitive results at earlier time points in the EPPE 3-11 research (entry to pre-school, at entry to primary school, end of Year 1, end of Year 2, end of Year 5, and end of Year 6). At the end of Year 9, mother's qualification is still a significant predictor of the cognitive attainment, regardless of how this was measured (see Appendix 4 for raw differences in test scores). Adolescents whose mothers have a degree or higher degree show the highest average TA levels in English, mathematics, and science ($M_{English\ TA}$=6.0; $M_{mathematics\ TA}$=6.7; $M_{science\ TA}$=6.2). The lowest attainment is seen for pupils whose mothers have no qualifications ($M_{English\ TA}$=4.6; $M_{mathematics\ TA}$=5.0; $M_{science\ TA}$=4.7).

Table 1.15: Cognitive Attainment in Year 9 by Mother's Highest Qualification – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	Mother's Highest Qualification	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**
Year 9 English Teacher Assessment	None	4.6	1.0	559	4.6	1.0	651
	Vocational	5.1	1.0	386	5.1	1.0	448
	Academic Age 16	5.1	1.0	1002	5.1	1.0	1120
	Academic Age 18	5.5	.9	197	5.5	0.9	247
	Degree or Higher Degree	6.0	.9	323	5.9	0.9	492
	Other professional	5.7	.9	37	5.6	1.0	44
Year 9 Mathematics Teacher Assessment	None	5.0	1.3	558	5.0	1.3	651
	Vocational	5.5	1.3	385	5.6	1.3	448
	Academic Age 16	5.7	1.4	1004	5.6	1.4	1120
	Academic Age 18	6.2	1.2	197	6.1	1.2	247
	Degree or Higher Degree	6.7	1.1	323	6.6	1.1	492
	Other professional	6.4	1.1	38	6.4	1.1	44
Year 9 Science Teacher Assessment	None	4.7	1.1	561	4.7	1.1	651
	Vocational	5.3	1.0	386	5.3	1.0	448
	Academic Age 16	5.3	1.0	1001	5.3	1.1	1120
	Academic Age 18	5.8	.9	197	5.7	1.0	247
	Degree or Higher Degree	6.2	.9	322	6.0	0.9	492
	Other professional	5.9	.9	38	5.8	0.9	44

Family Socio-Economic Status (SES) and Free School Meals (FSM)

Family SES is measured by the highest mother's or father's current or most recent employment status and showed a significant association with pupils' attainment levels at the end of Year 9. Even though the KS3 SES is significantly related to cognitive outcomes in Year 9, the earliest measure of family SES is more powerful in predicting test scores and TA levels. Therefore, the latter is presented here and was used in the multilevel models. The highest teacher evaluations were gained by pupils from higher SES group (e.g., the results for professional non manual are: $M_{English\ TA}$=5.9; $M_{mathematics\ TA}$=6.7; $M_{science\ TA}$=6.2). The lowest attainment is seen for pupils whose family SES was categorised as unskilled ($M_{English\ TA}$=4.6; $M_{mathematics\ TA}$=4.9; $M_{science\ TA}$=4.7).

Table 1.16: Cognitive Attainment in Year 9 by Family SES (Early Years) – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	Family SES	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**
Year 9 English Teacher Assessment	Professional Non Manual	5.9	.8	165	5.9	0.9	266
	Other Professional Non Manual	5.5	.9	605	5.5	1.0	756
	Skilled Non Manual	5.2	1.0	876	5.1	1.0	967
	Skilled Manual	4.8	1.0	398	4.8	1.0	450
	Semi Skilled	4.7	1.1	349	4.7	1.1	400
	Unskilled	4.6	1.0	68	4.6	1.0	76
	Never Worked	4.8	1.2	73	4.8	1.1	87
Year 9 Mathematics Teacher Assessment	Professional Non Manual	6.7	1.0	167	6.7	1.0	266
	Other Professional Non Manual	6.2	1.2	605	6.2	1.2	756
	Skilled Non Manual	5.7	1.3	879	5.6	1.3	967
	Skilled Manual	5.2	1.3	395	5.2	1.3	450
	Semi Skilled	5.1	1.4	348	5.1	1.4	400
	Unskilled	4.9	1.3	68	4.8	1.2	76
	Never Worked	5.4	1.5	72	5.3	1.5	87
Year 9 Science Teacher Assessment	Professional Non Manual	6.2	.9	163	6.1	0.9	266
	Other Professional Non Manual	5.8	1.0	606	5.7	1.0	756
	Skilled Non Manual	5.3	1.1	874	5.3	1.1	967
	Skilled Manual	4.9	1.0	400	4.9	1.0	450
	Semi Skilled	4.8	1.0	349	4.8	1.0	400
	Unskilled	4.7	1.2	69	4.7	1.2	76
	Never Worked	4.9	1.2	74	4.9	1.2	87

Pupils' eligibility for free school meals (FSM) provides an indicator of low family income (although it is recognised that not all pupils take up their entitlement). Table 1.17 shows that pupils who are reported to be eligible to receive free school meals (FSM) have lower average attainment on cognitive assessments compared to more advantaged families. The attainment gap is slightly larger for mathematics than for English or science. This pattern of results is in line with that found at younger ages, indicating that social disadvantage continues to show a statistically significant association with attainment.

Table 1.17: Cognitive Attainment in Year 9 by Free School Meals – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	FSM	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**
Year 9 English Teacher Assessment	No FSM	5.3	1.0	2041	5.3	1.0	2431
	FSM	4.6	1.1	504	4.6	1.1	571
Year 9 Mathematics Teacher Assessment	No FSM	5.8	1.3	2040	5.9	1.3	2431
	FSM	5.0	1.3	504	4.9	1.3	571
Year 9 Science Teacher Assessment	No FSM	5.4	1.1	2044	5.5	1.1	2431
	FSM	4.7	1.1	503	4.7	1.1	571

Special Educational Needs (SEN)

As might be expected, pupils identified in secondary school records as having any type of SEN showed significantly lower attainment in English, mathematics and science (see Table 1.18). Furthermore, those identified with a full SEN statement had the lowest results in all subjects.

Table 1.18: Cognitive Attainment in Year 9 by SEN – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	SEN Status	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	No special provision	5.4	.9	1976	5.4	0.9	2346
	School action	4.4	.9	299	4.5	1.0	348
	School action plus	4.2	1.0	163	4.3	1.0	204
	Statement of SEN	3.3	1.2	84	3.5	1.3	105
Year 9 Mathematics Teacher Assessment	No special provision	6.0	1.2	1973	6.0	1.2	2346
	School action	4.7	1.2	299	4.8	1.2	348
	School action plus	4.4	1.2	168	4.6	1.3	204
	Statement of SEN	3.6	1.3	81	3.8	1.4	105
Year 9 Science Teacher Assessment	No special provision	5.6	1.0	1976	5.6	1.0	2346
	School action	4.6	1.0	300	4.6	1.0	348
	School action plus	4.4	1.0	165	4.5	1.1	204
	Statement of SEN	3.7	1.3	83	3.9	1.4	105

Early Years Home Learning Environment (HLE)

The Early Years HLE had been shown to have a strong significant positive impact on pupils' cognitive outcomes at earlier time points. At the end of Year 9, the Early Years HLE index still shows a strong linear relationship with average cognitive attainment; the better the Early home learning, the higher the TA levels at Year 9 (see Table 1.19, but also Appendix 4).

Table 1.19: Cognitive Attainment in Year 9 by Early Years HLE Index – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	Early Years HLE	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	0-13	4.7	1.1	238	4.6	1.1	293
	14-19	4.9	1.1	576	4.9	1.1	665
	20-24	5.1	1.0	621	5.1	1.0	732
	25-32	5.3	1.0	779	5.4	1.0	965
	33-45	5.7	.9	278	5.7	0.9	347
Year 9 Mathematics Teacher Assessment	0-13	5.1	1.4	235	5.0	1.4	293
	14-19	5.4	1.4	576	5.4	1.4	665
	20-24	5.6	1.3	623	5.6	1.3	732
	25-32	5.9	1.3	783	5.9	1.3	965
	33-45	6.4	1.2	276	6.4	1.2	347
Year 9 Science Teacher Assessment	0-13	4.8	1.1	238	4.8	1.1	293
	14-19	5.1	1.1	579	5.1	1.1	665
	20-24	5.3	1.1	622	5.3	1.1	732
	25-32	5.5	1.0	777	5.5	1.0	965
	33-45	5.9	.9	277	5.9	1.0	347

The Key Stage 1 Home Learning Environment (HLE)

Table 1.20 shows the correlations of different dimensions of the KS1 HLE and Early Years HLE. Most of the correlations are statistically significant although modest in size. This might be due to the way the two HLEs were measured: the Early Years HLE was obtained from parents' interviews, while KS1 HLE was obtained from parents filling in questionnaires. Additionally, modest relationships could be expected as over time there are important changes in the children's HLE activities at home during pre-school and these are different from the activities performed at older ages.

Table 1.20: Correlations Between Early Years HLE and KS1 HLE Factors – Original Data

	KS1 HLE Computing	KS1 HLE Interactions	KS1 HLE Outings	KS1 HLE Play
Early Years HLE	0.04^{ns} (N=1978)	0.15 (N=1978)	0.34 (N=1978)	0.14 (N=1978)
KS1 HLE Interactions	-0.004^{ns} (N=2049)			
KS1 HLE Outing	-0.0008^{ns} (N=2049)	0.002^{ns} (N=2049)		
KS1 HLE Play	-0.003^{ns} (N=2049)	-0.003^{ns} (N=2049)	-0.0009^{ns} (N=2049)	

When we do not control for any individual or family characteristics, the differences in cognitive attainment show that a medium level of KS1 HLE related to computing activities was associated with higher levels in all three subjects. Similar results were obtained for KS1 HLE related to parent-child interactions and expressive play (see Table 1.22 and Table 1.24). Conversely, a higher frequency of parent-child activities outside the home was associated with better cognitive outcomes in English, mathematics and science (see Table 1.23).

Table 1.21: Cognitive Attainment in Year 9 by KS1 HLE Computing – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	KS1 HLE Computing	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	Low KS1 HLE	5.2	1.0	307	5.1	1.1	513
	Medium KS1 HLE	5.3	1.0	1181	5.2	1.1	2036
	High KS1 HLE	5.0	.9	260	5.0	1.0	453
Year 9 Mathematics Teacher Assessment	Low KS1 HLE	5.6	1.4	310	5.5	1.4	513
	Medium KS1 HLE	5.9	1.3	1180	5.8	1.4	2036
	High KS1 HLE	5.7	1.3	258	5.6	1.4	453
Year 9 Science Teacher Assessment	Low KS1 HLE	5.2	1.1	307	5.2	1.1	513
	Medium KS1 HLE	5.5	1.1	1180	5.4	1.1	2036
	High KS1 HLE	5.2	1.1	260	5.2	1.1	453

Table 1.22: Cognitive Attainment in Year 9 by KS1 HLE Interactions – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	KS1 HLE Interactions	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	Low KS1 HLE	5.2	1.1	259	5.1	1.1	460
	Medium KS1 HLE	5.3	1.0	1246	5.2	1.1	2103
	High KS1 HLE	5.2	1.0	243	5.2	1.0	439
Year 9 Mathematics Teacher Assessment	Low KS1 HLE	5.7	1.4	259	5.6	1.4	460
	Medium KS1 HLE	5.9	1.3	1245	5.7	1.4	2103
	High KS1 HLE	5.7	1.4	244	5.6	1.4	439
Year 9 Science Teacher Assessment	Low KS1 HLE	5.2	1.1	258	5.2	1.1	460
	Medium KS1 HLE	5.5	1.1	1250	5.4	1.1	2103
	High KS1 HLE	5.4	1.2	239	5.4	1.2	439

Table 1.23: Cognitive Attainment in Year 9 by KS1 HLE Outings – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	KS1 HLE Outings	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	Low KS1 HLE	4.7	.9	247	4.7	1.0	457
	Medium KS1 HLE	5.3	1.0	1320	5.2	1.1	2158
	High KS1 HLE	5.6	.9	181	5.5	1.0	387
Year 9 Mathematics Teacher Assessment	Low KS1 HLE	5.2	1.3	246	5.1	1.4	457
	Medium KS1 HLE	5.9	1.3	1322	5.8	1.4	2158
	High KS1 HLE	6.1	1.2	180	6.1	1.3	387
Year 9 Science Teacher Assessment	Low KS1 HLE	4.9	1.0	248	4.9	1.1	457
	Medium KS1 HLE	5.5	1.1	1320	5.4	1.1	2158
	High KS1 HLE	5.7	.9	179	5.6	1.0	387

Table 1.24: Cognitive Attainment in Year 9 by KS1 HLE Play – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	KS1 HLE Play	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	Low KS1 HLE	5.0	1.0	277	5.0	1.1	492
	Medium KS1 HLE	5.3	1.0	1169	5.2	1.1	2016
	High KS1 HLE	5.3	.9	302	5.2	1.0	494
Year 9 Mathematics Teacher Assessment	Low KS1 HLE	5.7	1.5	276	5.6	1.5	492
	Medium KS1 HLE	5.9	1.3	1171	5.7	1.4	2016
	High KS1 HLE	5.7	1.3	301	5.7	1.3	494
Year 9 Science Teacher Assessment	Low KS1 HLE	5.3	1.2	276	5.2	1.2	492
	Medium KS1 HLE	5.5	1.1	1168	5.4	1.1	2016
	High KS1 HLE	5.4	1.1	303	5.3	1.1	494

The Key Stage 2 Home Learning Environment (HLE)

Similar to the correlations between Early Years HLE and KS1 HLE, KS2 HLE relates modestly to previous HLE (see Table 1.25). The differences in TA average levels show that both medium and high KS2 HLE were associated with better cognitive outcomes in English, mathematics and science (see Table 1.26 and Table 1.27). As previously noted, these results should be taken cautiously as they are not net effects.

Table 1.25: Correlations Between Early Years HLE and KS1 HLE Factors – Original Data

	KS2 HLE Educational Computing	KS2 HLE Individual Activities
Early Years HLE	0.18 (N= 1832)	0.29 (N=1832)
KS1 HLE Computing	0.22 (N= 1485)	0.03^{ns} (N= 1485)
KS1 HLE Interactions	0.08 (N=1485)	0.14 (N=1485)
KS1 HLE Outings	0.17 (N=1485)	0.18 (N=1485)
KS1 HLE Play	0.11 (N=1485)	0.37 (N=1485)

Table 1.26: Cognitive Attainment in Year 9 by KS2 HLE Educational Computing – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	KS2 HLE Educational Computing	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**
Year 9 English Teacher Assessment	Low KS2 HLE	4.9	1.1	272	4.9	1.1	497
	Medium KS2 HLE	5.4	1.0	1149	5.3	1.1	2072
	High KS2 HLE	5.3	.9	215	5.2	1.0	433
Year 9 Mathematics Teacher Assessment	Low KS2 HLE	5.3	1.5	272	5.2	1.4	497
	Medium KS2 HLE	6.0	1.3	1151	5.8	1.4	2072
	High KS2 HLE	5.8	1.3	216	5.7	1.4	433
Year 9 Science Teacher Assessment	Low KS2 HLE	5.0	1.2	272	5.0	1.2	497
	Medium KS2 HLE	5.5	1.0	1149	5.4	1.1	2072
	High KS2 HLE	5.5	1.0	217	5.3	1.1	433

Table 1.27: Cognitive Attainment in Year 9 by KS2 HLE Individual Activities – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	KS2 HLE Individual Activities	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	Low KS2 HLE	4.9	1.0	253	4.8	1.1	466
	Medium KS2 HLE	5.4	1.0	1144	5.2	1.1	2068
	High KS2 HLE	5.5	.9	239	5.4	1.0	468
Year 9 Mathematics Teacher Assessment	Low KS2 HLE	5.5	1.4	252	5.4	1.4	466
	Medium KS2 HLE	5.9	1.3	1149	5.8	1.4	2068
	High KS2 HLE	5.8	1.3	238	5.8	1.3	468
Year 9 Science Teacher Assessment	Low KS2 HLE	5.1	1.2	253	5.0	1.1	466
	Medium KS2 HLE	5.5	1.1	1146	5.4	1.1	2068
	High KS2 HLE	5.5	1.0	239	5.5	1.1	468

Pre-school Attendance

Findings from earlier analyses (start of primary school, at the end of Year 1, Year 2 and Year 6) showed beneficial effects of attending a pre-school on cognitive outcomes when compared with not attending a pre-school. At the end of Year 9, pupils who had attended pre-school still have higher average TA levels than pupils who had not attended pre-school (see Table 1.28).

Due to the very different characteristics of the 'home' group (for example, disadvantaged pupils are over-represented in this group) and very different characteristics of pupils who went to different types of pre-school centre, these raw differences need to be interpreted with considerable caution. Further analyses are required to separate the 'net' pre-school effects from those related to background characteristics. Section 3 investigates the impact of attendance, quality and effectiveness of pre-school in more detail, controlling for the influence of differences in pupils' background characteristics.

Table 1.28: Cognitive Attainment in Year 9 by Pre-school Attendance – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample		
	Pre-school Attendance	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Year 9 English Teacher Assessment	Pre-school Experience	5.2	1.0	2325	5.2	1.0	2721
	No Pre-school Experience	4.7	1.1	249	4.8	1.1	281
Year 9 Mathematics Teacher Assessment	Pre-school Experience	5.7	1.4	2328	5.8	1.4	2721
	No Pre-school Experience	5.0	1.4	246	5.1	1.4	281
Year 9 Science Teacher Assessment	Pre-school Experience	5.4	1.1	2325	5.4	1.1	2721
	No Pre-school Experience	4.8	1.1	250	4.8	1.1	281

It would be inappropriate to explore any continuing influence of pre-school, primary or secondary school on subsequent educational outcomes at the end of Year 9 unless proper statistical control is made of the influence of intake differences. The next section therefore examines the net influence of different individual pupil, family and HLE characteristics in contextualised multilevel statistical models, which identify and separate the various influences simultaneously. The additional 'net' influence of pre-school, primary and secondary school experience are then explored for the whole EPPSE 3-14 sample and for relevant sub-groups.

2. Pupils' Cognitive Attainment at the End of Year 9 in Secondary School: The Impact of Different Individual Pupil, Family and Home Learning Environment (HLE) Characteristics

This section presents the results of contextualised multilevel analyses establishing the pattern of relationships between various individual pupil, family and HLE characteristics and pupils' cognitive attainment at the end of Year 9. Background details concerning the pupils' earlier childcare experiences, health, family and HLE during the pre-school period were obtained from parental interviews conducted when pupils entered the EPPE study, a parent questionnaire completed by the parents when pupils were in KS1 of primary school education and a parent questionnaire completed by the parents when pupils were in KS2 of primary school education.

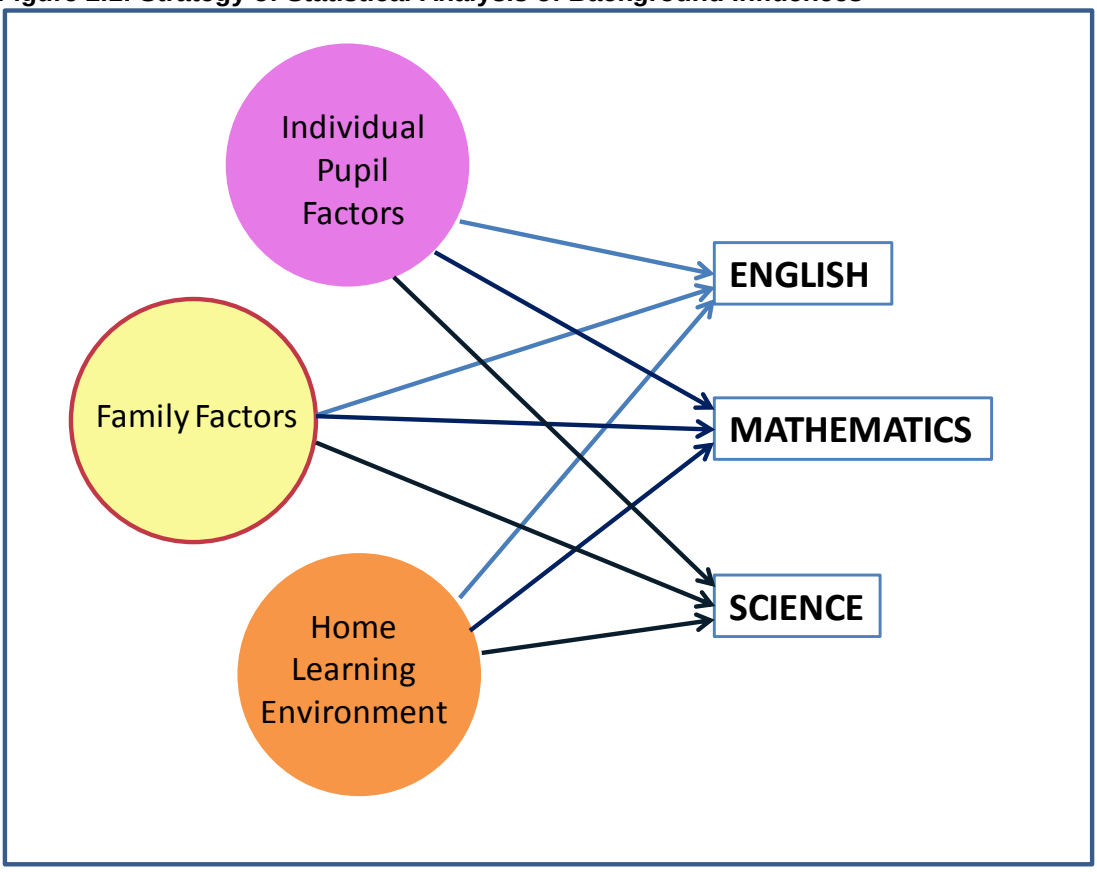
As potentially influencing background factors, the following measures have been used in the analyses:

- Individual pupil factors (i.e., gender, birth weight, number of siblings, early developmental problems, early behavioural problems, early health problems, ethnicity).
- Family factors (i.e., socio-economic status [SES], parent's qualification levels, family income[16]).
- Home learning environment (HLE) in the early years (parents reported how often they read to the child, taught the child the alphabet, played with letters & numbers, taught songs & nursery rhymes, painted & drew etc.) before starting primary school.
- Parental activities during KS1 such as the frequency of reading to the child, taking the child out to educational visits, computing activities, play, etc. (see Appendix 5 for details of these measures).
- KS2 HLE included activities such as computing, playing, reading etc. (see Appendix 5 for details of these measures).

Figure 2.1 illustrates the strategy of the statistical analysis. The analyses investigated the associations between cognitive attainment and individual pupil, family and HLE characteristics when the pupils reach the end of Year 9 of secondary school education[17]. The analysis of the influence of individual pupil, family and HLE characteristics on cognitive outcomes is an important step as only on this basis, is it possible to separately identify and quantify the 'net' influence of pre-school, primary school education and secondary school. These influences will be explored in Section 3. The extent of differences in TA levels attributable to pupil background is also of considerable policy interest given the equity implications for later progress at school. The 'net' effects of particular individual pupil, family and HLE characteristics reported in this section were derived by contextualised multilevel analyses and therefore take into account any clustering related to the secondary school attended.

[16] Marital status at KS2 was also included in initial analysis but did not prove significant.
[17] It should be noted that all the analyses also accounted for associations between the predictors which could have been illustrated by additional arrows. For simplicity these arrows are not shown in Figure 2.1.

Figure 2.1: Strategy of Statistical Analysis of Background Influences



2.1. Null Models

In order to control for potential secondary school influences and to take account of the clustering in the data, multilevel analyses were used to partition the variance in the TA levels that is attributable to the school (Level 2) and the individual pupil (Level 1). This models the effects of clustering in the data (because pupils are nested in schools) and is widely recognized as essential in studying school influences (Creemers, Kyriakides & Sammons, 2010; Goldstein, 1995; 2003; Teddlie & Reynolds, 2000).

Table 2.1, Table 2.3 and Table 2.5 show the null models for TA levels in English, mathematics and science. For English TA levels, the school and pupil level variances are very similar for the original and imputed data. Similarly, for mathematics and science, the imputed models show similar variances at both pupil and school levels on the original data (with the exception for science, where the school level variance for imputed data is slightly higher than the corresponding variance on the original data). These initial results suggest that the imputation procedure was robust in relation to the multilevel structure of the data set.

The intra-school correlations (ICC) for all three cognitive outcomes show that there is significant school level variation (approximately 20-24%) so that pursuing the analyses with multilevel models is essential to avoid bias in estimating the effects of the predictors.

Table 2.1: Null Models for English Teacher Assessment Levels in Year 9 - Original and Imputed Data

	Year 9 English TA Original data		Year 9 English TA Imputed Data STATA ICE	
Number of pupils	**2574**		**3002**	
Number of schools	**583**		**800**[18]	
	Coef	**SE**	**Coef**	**SE**
School variance	0.28	0.04	0.31	
Residual variance	0.89	0.03	0.89	
Intra-school correlation (ICC)	0.2397		0.2588	

Table 2.2: Null Models for English National Assessment Test Scores in Year 9 - Original and Imputed Data

	Year 9 English Test Score Original data		Year 9 English Test Score Imputed Data STATA ICE	
Number of pupils	**1143**		**3002**	
Number of schools	**332**		**800**	
	Coef	**SE**	**Coef**	**SE**
School variance	43.22	8.61	46.52	
Residual variance	179.08	8.43	202.86	
Intra-school correlation (ICC)	0.1944		0.1866	

Table 2.3: Null Models for Mathematics Teacher Assessment Levels in Year 9 - Original and Imputed Data

	Year 9 Maths TA Original data		Year 9 Maths TA Imputed Data STATA ICE	
Number of pupils	**2574**		**3002**	
Number of schools	**585**		**800**	
	Coef	**SE**	**Coef**	**SE**
School variance	0.36	0.06	0.42	
Residual variance	1.58	0.05	1.56	
Intra-school correlation (ICC)	0.1887		0.2103	

Table 2.4: Null Models for Mathematics National Assessment Test Scores in Year 9 - Original and Imputed Data

	Year 9 Maths Test Score Original data		Year 9 Maths Test Score Imputed Data STATA ICE	
Number of pupils	**1186**		**3002**	
Number of schools	**345**		**800**	
	Coef	**SE**	**Coef**	**SE**
School variance	38.04	8.64	49.29	
Residual variance	188.61	8.79	194.59	
Intra-school correlation (ICC)	0.1679		0.2021	

Table 2.5: Null Models for Science Teacher Assessment Levels in Year 9 - Original and Imputed Data

	Year 9 Science TA Original data		Year 9 Science TA Imputed Data STATA ICE	
Number of pupils	**2575**		**3002**	
Number of schools	**585**		**800**	
	Coef	**SE**	**Coef**	**SE**
School variance	0.30	0.04	0.30	
Residual variance	0.98	0.03	0.99	
Intra-school correlation (ICC)	0.2366		0.2330	

[18] We assigned dummy values for secondary school IDs for the cases (N=63, 2%) where any information on secondary school in Year 9 was missing

Table 2.6: Null Models for Science National Assessment Test Scores in Year 9 - Original and Imputed Data

	Year 9 Science Test Score Original data		Year 9 Science Test Score Not Imputed	
Number of pupils	**1186**			
Number of schools	**344**			
	Coef	**SE**	**Coef**	**SE**
School variance	40.07	8.66		
Residual variance	184.59	8.59		
Intra-school correlation (ICC)	0.1784			

2.2. Individual Measures

Examining the associations between individual factors and attainment in English TA levels in Year 9, we found that age, gender, birth weight, early developmental and behavioural problems, and family size were statistically significant predictors. Their relative strength is shown by the effect sizes (ES) in Table 2.7. For mathematics at the end of Year 9 the following child characteristics are found to have a statistically significant net effect: gender, birth weight, ethnicity and early development and behavioural problems. Their relative strength is shown by the ES in Table 2.8. Regarding the cognitive attainment in science, predictors such as age, birth weight, ethnicity and early development problems had statistically significant net effects (see the specific ES in Table 2.9). The overall models are presented in Appendix 6.

Age

As the main cognitive outcomes were TA levels, these were not age standardised. Therefore, in the contextualised models we found a statistically significant age effect for English (ES_{Orig}=0.19; $ES_{Imputed}$=0.19), mathematics (ES_{Orig}=0.15; $ES_{Imputed}$=0.15) and science TA levels (ES_{Orig}=0.16; $ES_{Imputed}$=0.15). Older pupils tend to perform better than younger ones in English, mathematics and science.

Gender

Females obtained higher TA levels in English than males (ES_{Orig}=0.46; $ES_{Imputed}$=0.41). This result is consistent with results at earlier time points. Additionally, at earlier time points, girls also showed statistically significantly higher attainment in mathematics than boys. However, male pupils now tend to show a slightly higher attainment than females in mathematics, although the difference is not statistically significant.

Birth Weight

Pupils who were born with very low birth weight had statistically significantly lower attainment in English (ES_{Orig}=0.37; $ES_{Imputed}$=0.53), mathematics (ES_{Orig}=0.40; $ES_{Imputed}$=0.59) and science (ES_{Orig}=0.35; $ES_{Imputed}$=0.49) in Year 9 than those born with normal birth weight[19]. This is in line with findings at earlier time points, with the effect stronger for mathematics than for English and science.

Ethnicity

In Year 9 there is no statistically significant ethnicity effect on attainment in English, but in mathematics and science, pupils from Indian heritage obtained higher teacher assessment levels

[19] Babies born weighing 2500 grams or less are defined as below normal birth weight: foetal infant classification is below 1000 grams, very low birth weight is classified as 1001-1500 grams and low birth weight is classified as 1501-2500 grams (Scott & Carran, 1989). In the present analyses, the categories foetal infant (<1000g) and very low birth weight (1001-1005g) were collapsed into one category due to small numbers in the former group.

than other pupils (mathematics: ES_{Orig}=0.37; $ES_{Imputed}$=0.32; science: ES_{Orig}=0.30; $ES_{Imputed}$=0.22^{ns}).

Family Size

At earlier ages, pupils from larger families (with 3 or more siblings) showed statistically significantly lower attainment in English and mathematics but not in science. In Year 6 there were no statistically significant differences in terms of family size. In the present analysis, adolescents with 3 siblings or more obtained lower levels in both English and mathematics. The cognitive attainment in English for pupils with 3 or more siblings was lower with a quarter of a TA level than for the pupils with no siblings.

Early Developmental and Behavioural Problems

Pupils whose parents reported early developmental and behavioural problems at the beginning of the pre-school phase of the study still showed lower attainment both in English and mathematics in Year 9 compared to pupils where no early developmental or behavioural problems were reported.

Table 2.7: Factors with Statistically Significant 'Net' Effect on English Teacher Assessment Levels in Year 9

Factor	Effect Size Original Data	Effect Size Imputed Data	Description
Age	0.19	0.19	Older pupils perform better than younger.
Gender	0.46	0.41	Females obtain higher attainment than males.
Birth Weight	0.37	0.53	Pupils born with normal birth weight achieve higher cognitive attainment than those born with very low birth weight.
Early Developmental Problems	0.21	0.22	One or more early developmental problems are predictors for lower cognitive achievement.
Early Behavioural Problems	0.18	0.20	One or more behavioural problems are predictors for lower cognitive achievement.
Number of Siblings	0.31	0.25	Three siblings or more predict lower cognitive achievement.
Mother's Age	0.16	0.12	Pupils with older mothers have better cognitive attainment.
Mother's qualifications	0.61	0.49	Higher mother's qualification is predictor of better cognitive attainment.
Father's qualifications	0.36	0.27	Higher father's qualification is predictor of better cognitive attainment.
Year 9 FSM	0.30	0.30	Receiving of being eligible for FSM is a negative predictor for cognitive attainment.
Family Socio-Economic Status	0.29	0.30	Pupils from families with higher SES perform better.
Family income	0.40	0.30	Pupils from families with high income perform better.
School Level FSM	0.19	0.18	Pupils from schools with high percentage of young adults receiving FSM have lower attainment.
Early years HLE	0.29	0.36	Higher scores on Early Years HLE are associated with higher attainment.
KS1 HLE	0.24	0.19	Frequent outdoors activities are associated with higher achievement.
KS2 HLE	0.19	0.15	Moderate computing usage is better than frequent computer usage.

Table 2.8: Factors with Statistically Significant 'Net' Effect on Mathematics Teacher Assessment Levels in Year 9

Factor	Effect Size Original Data	Effect Size Imputed Data	Description
Age	0.15	0.15	Older pupils perform better than younger.
Birth Weight	0.40	0.59	Pupils born with normal birth weight achieve higher cognitive attainment than those born with very low birth weight.
Ethnicity	0.37	0.32	Indian heritage better attainment than White UK heritage.
Early Developmental Problems	0.16	0.21	One or more early developmental problems are predictors for lower cognitive achievement.
Early Behavioural Problems	0.18	0.22	One or more behavioural problems are predictors for lower cognitive achievement.
Number of Siblings	0.19	0.14	Three siblings or more predict lower cognitive achievement.
Mother's qualifications	0.50	0.48	Higher mother's qualification is predictor of better cognitive attainment.
Father's qualifications	0.37	0.20	Higher father's qualification is predictor of better cognitive attainment.
Year 9 FSM	0.31	0.31	Receiving of being eligible for FSM is a negative predictor for cognitive attainment.
Family Socio-Economic Status	0.36	0.53	Pupils from families with higher SES perform better.
Family income	0.21	0.21	Pupils from families with higher income perform better.
School Level FSM	0.20	0.17	Pupils from schools with high percentage of young adults receiving FSM have lower attainment.
Early years HLE	0.38	0.42	Higher scores on Early Years HLE are associated with higher attainment.
KS2 HLE	0.17	0.17	Moderate computing usage is better than frequent computer usage.

Table 2.9: Factors with Statistically Significant 'Net' Effect on Science Teacher Assessment Levels in Year 9

Factor	Effect Size Original Data	Effect Size Imputed Data	Description
Age	0.16	0.15	Older pupils perform better than younger.
Birth Weight	0.33[ns] (0.35)[20]	0.48 (0.49)	Pupils born with normal birth weight achieve higher cognitive attainment than those born with very low birth weight.
Ethnicity	0.30	0.22[ns]	Indian heritage better attainment than White UK heritage.
Early Developmental Problems	0.15	0.21	One or more early developmental problems are predictors for lower cognitive achievement.
Mother's Age	0.09	0.07[ns]	Pupils with older mothers have better cognitive attainment.
Mother's qualifications	0.61	0.53	Higher mother's qualification is predictor of better cognitive attainment.
Father's qualifications	0.48	0.26	Higher father's qualification is predictor of better cognitive attainment.
Year 9 FSM	0.31	0.29	Receiving of being eligible for FSM is a negative predictor for cognitive attainment.
Family Socio-Economic Status	0.31	0.40	Pupils from families with higher SES perform better.
Family income	0.29[21]	0.18[ns]	Pupils from families with high income perform better.
School Level FSM	0.22	0.20	Pupils from schools with high percentage of young adults receiving FSM have lower attainment.
Early years HLE	0.41	0.36	Higher scores on Early Years HLE are associated with higher attainment.
KS1 HLE	0.15	0.09[ns]	Frequent outdoors activities are associated with higher achievement.
KS2 HLE	0.17	0.15	Moderate individual activities are better than frequent ones.

2.3. Family Measures

Regarding the background characteristics we found the following family factors having a statistically significant net effect on attainment in English, mathematics and science: mother's age, parents' qualification levels, eligibility for FSM, family SES, family's salary and school level FSM. The relative strength of different factors is indicated by the effect sizes (ES).

Mother's age

Mother's age was found to be a positive predictor for attainment in English and science. Mother's age was not significantly related to the educational attainment in mathematics. The effect sizes were slightly stronger for English than for science (English: ES_{Orig}=0.16; science: ES_{Orig}=0.09) and the estimates did not reach significance on the imputed data for science.

Parent's Highest Qualification Level

Both mother's and father's education were tested in the contextualised models to examine their associations with cognitive outcomes. Mother's education, as measured by the highest level of qualification, continued to show a consistent pattern of strong and positive effects. The categories degree and higher degree showed the strongest positive influence (compared with the group that

[20] Effect size in the contextualised model that does not control for Year 9 FSM status

[21] Significant only in the contextualised model that does not control for Year 9 FSM status

had no qualifications) for results in English, mathematics and science (English: ES_{Orig}=0.61; $ES_{Imputed}$=0.49; mathematics: ES_{Orig}=0.50; $ES_{Imputed}$=0.48; science: ES_{Orig}=0.61; $ES_{Imputed}$=0.53). Thus, pupils whose mothers have a degree or higher degree gain a half of a TA level in English and more than half of a TA level in mathematics and science when compared to pupils whose mothers have no qualification. See Figure 2.2, Figure 2.3, and Figure 2.4 for details on effect sizes for other qualification levels compared to no qualification.

Also important for pupils' cognitive attainment is the father's qualification. Having a father with a degree or a higher degree is statistically significantly associated with higher levels in the pupils' English, mathematics and science TA (English: ES_{Orig}=0.36; $ES_{Imputed}$=0.27; mathematics: ES_{Orig}=0.37; $ES_{Imputed}$=0.20; science: ES_{Orig}=0.48; $ES_{Imputed}$=0.26). It seems that both parents' qualifications are important for cognitive attainment in Year 9, but the mother's qualification level show a stronger link to pupils' attainment (see Table A.6.1-Table A.6.3 in Appendix 6 for further details on effect sizes for different predictors).

Figure 2.2: The Net Effect of Mother's Highest Qualification on English Teacher Assessment Levels in Year 9

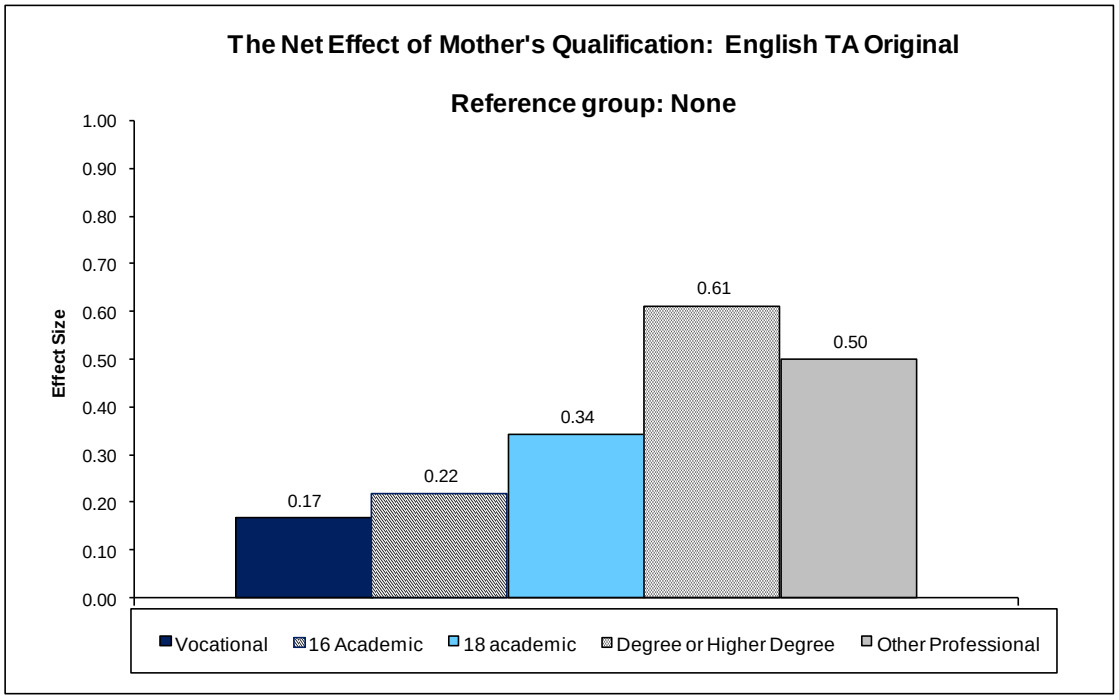


Figure 2.3: The Net Effect of Mother's Highest Qualification on Mathematics Teacher Assessment Levels in Year 9

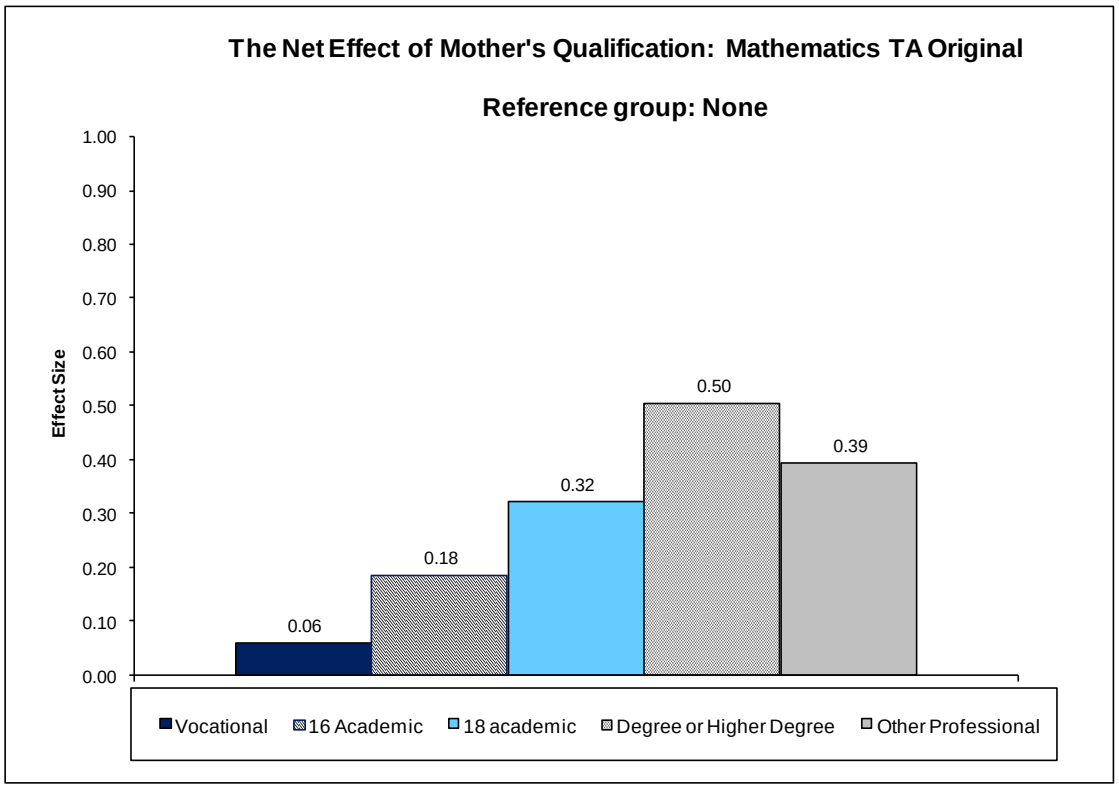
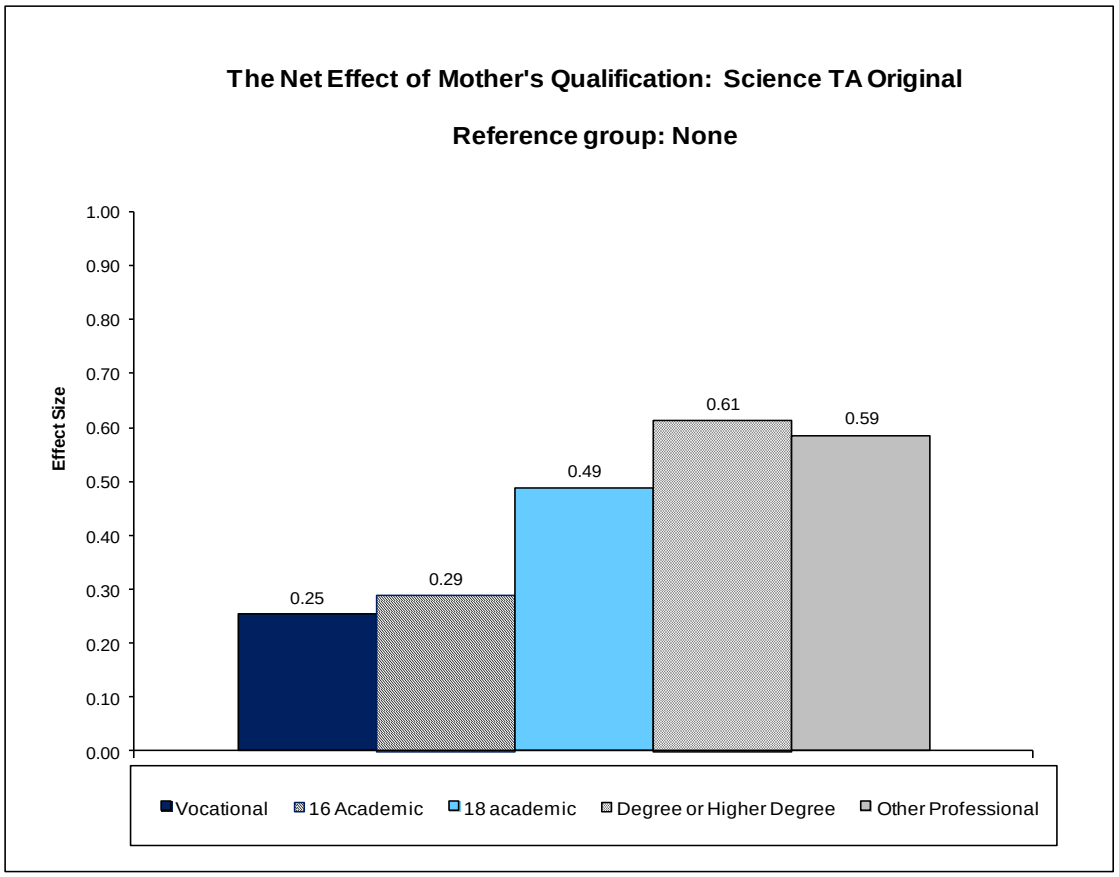


Figure 2.4: The Net Effect of Mother's Highest Qualification on Science Teacher Assessment Levels in Year 9



Free School Meals (FSM)
FSM, a marker for low income, was a negative predictor of cognitive attainment in Year 9; pupils eligible or receiving FSM performed worse than pupils who were not eligible. The ES were similar for English, mathematics and science (English: ES_{Orig}=0.30; $ES_{Imputed}$=0.30; mathematics: ES_{Orig}=0.31; $ES_{Imputed}$=0.31; science: ES_{Orig}=0.31; $ES_{Imputed}$=0.29)[22]. Pupils eligible or receiving FSM lost a quarter of a TA level in English and almost a third of a TA level in science when compared to pupils with no FSM.

Income
In terms of household salary, the results indicate that pupils in households with incomes of more than £37,500 per annum have better levels in English TA than those whose parents have no salary (ES_{Orig}=0.20; $ES_{Imputed}$=0.22). Higher salaries than £67,500 per annum were associated with an increase of a third of a TA level in English when compared to no salaries. The effect sizes obtained for mathematics for the "£37,500 – £66,000" salary category were ES_{Orig}=0.21 and $ES_{Imputed}$=0.21. Pupils from families with salaries between £37,500 and £66,000 gained a quarter of a TA level in mathematics when compared to pupils from families with no salaries. For science, family income was statistically significant only when the Year 9 FSM was removed from the contextualised model (Salary higher than £67,500: ES_{Orig}=0.29; $ES_{Imputed}$=0.18^{ns}).

Family SES
Family SES was computed for different time points: entry into the study, KS1, KS2 and KS3. Even though each of these alternatives of family SES was a significant predictor of cognitive outcome, the best and most robust predictor was the family SES collected at the entry time by interviewing the parents. Therefore, the contextualised models based on this predictor were reported.

When compared with the 'professional non-manual' category (representing the highest possible SES category), all the other categories predicted lower levels of TA in English and science. However, statistically significant lower attainment in English was found for pupils whose parents belong to the 'skilled manual' group (ES_{Orig}=-0.29; $ES_{Imputed}$=-0.30; see Figure 2.5). For mathematics, more groups were significantly different from the highest category: 'skilled manual' 'semi-skilled' and 'unskilled' (see Figure 2.6). Pupils whose parents were in any of these categories performed significantly worse than the comparison group. The educational attainment in science was significantly related to the following SES categories 'skilled non manual', 'skilled manual' and 'semi-skilled' (see Figure 2.7).

[22]Note that effects cannot be compared directly to effect sizes that have been reported for earlier time points, because for these analyses an improved imputed measure has been used.

Figure 2.5: The Net Effect of Family SES on English Teacher Assessment Levels in Year 9

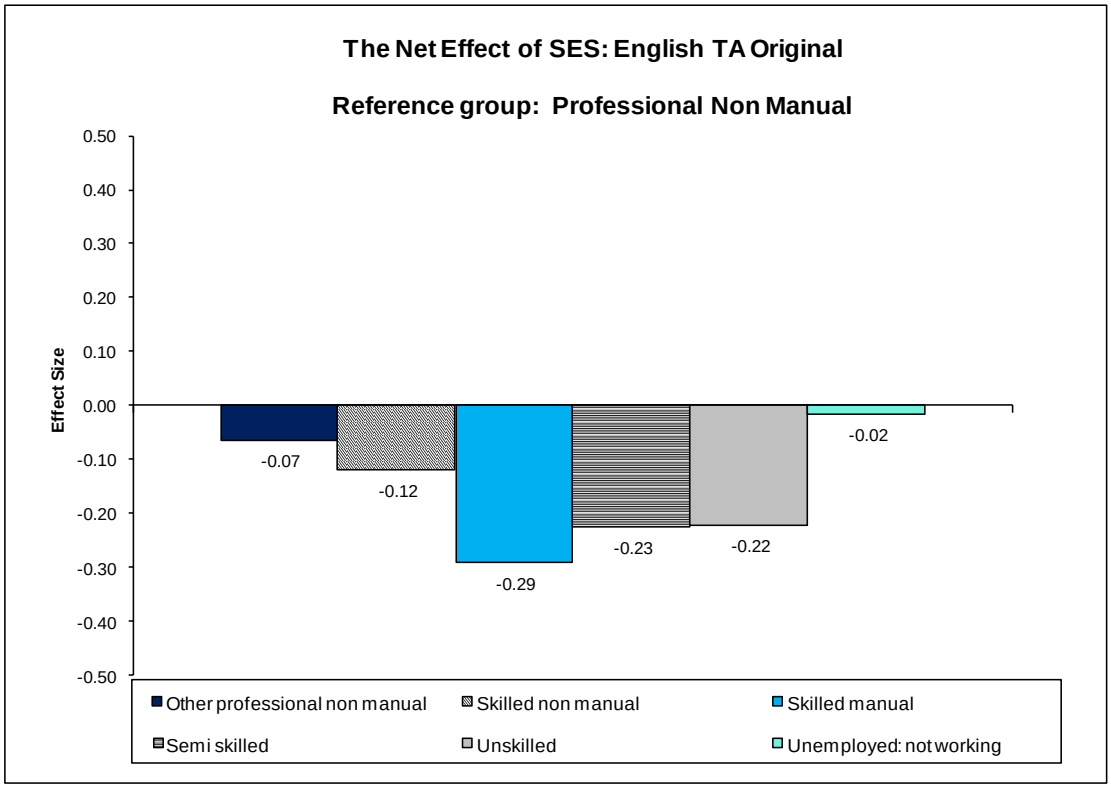


Figure 2.6: The Net Effect of Family SES on Mathematics Teacher Assessment Levels in Year 9

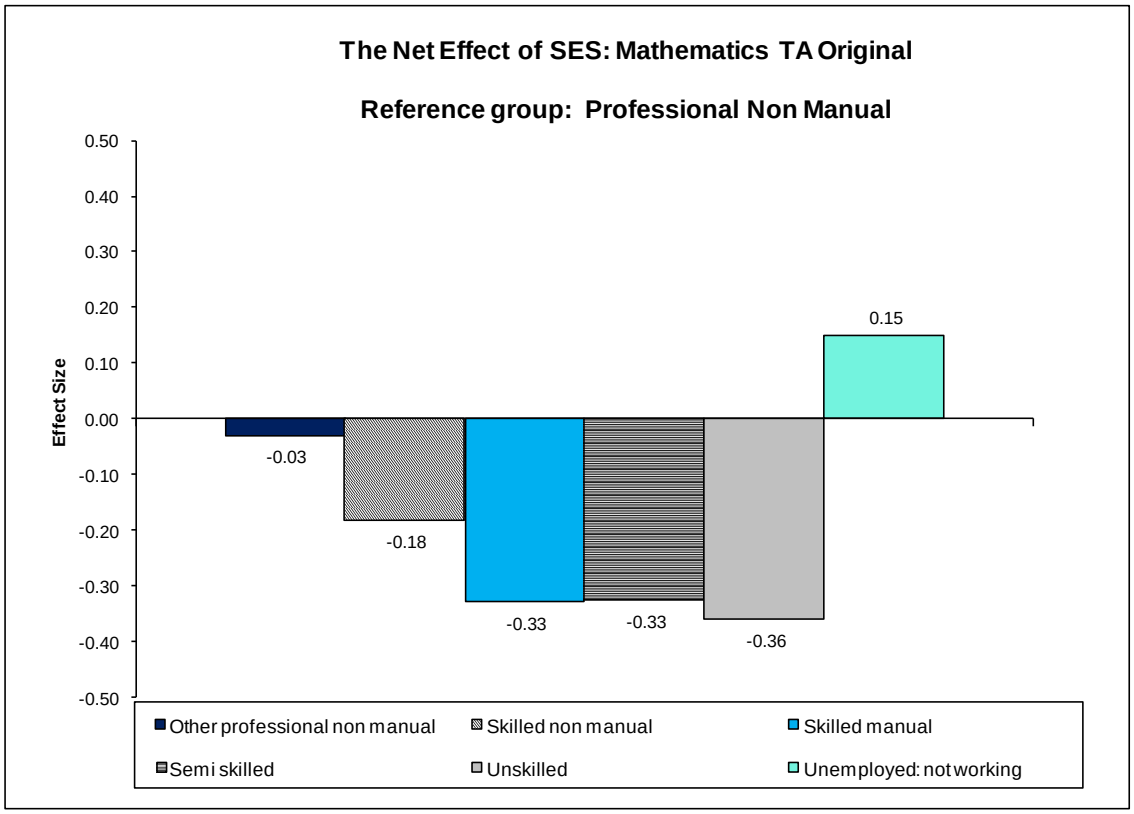
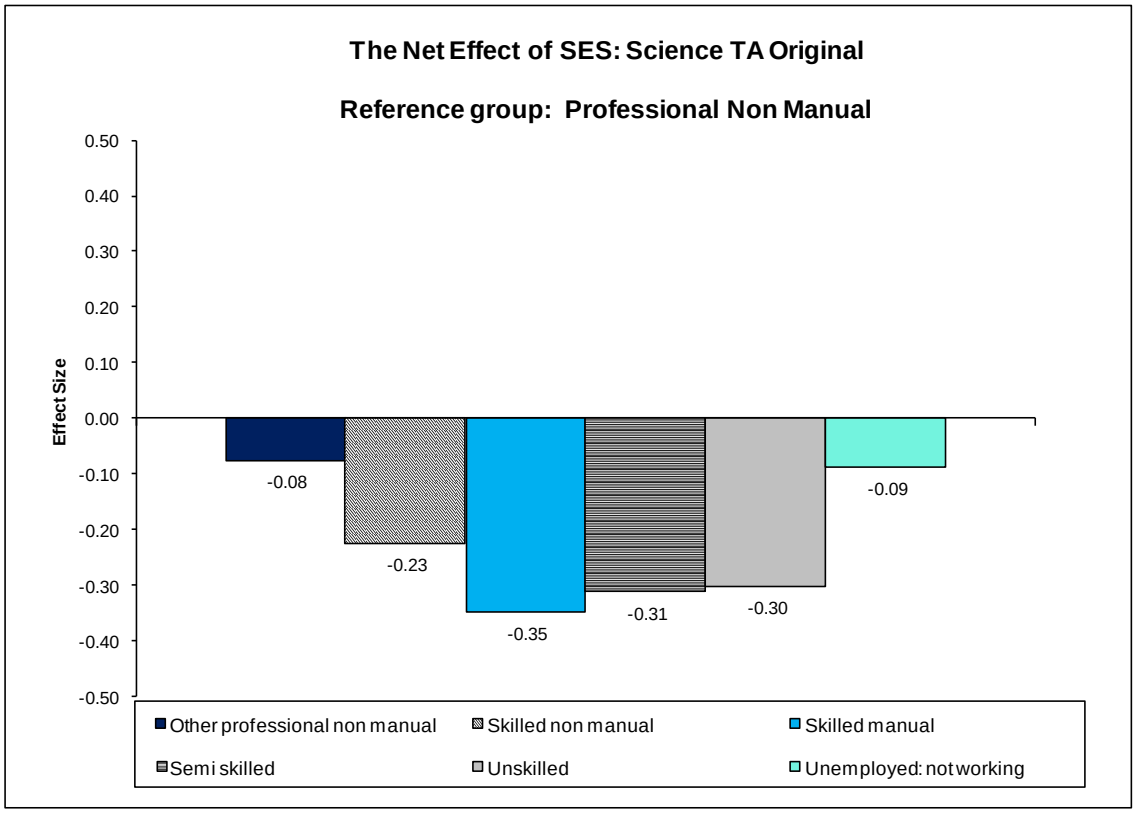


Figure 2.7: The Net Effect of Family SES on Science Teacher Assessment Levels in Year 9



Overall results revealed that pupils whose parents belong to the highest SES group - professional non-manual - continue to have significantly higher attainment levels, net of the influence of income and qualifications, although qualifications have stronger relationships with cognitive outcomes than income or family SES.

Early Years Home Learning Environment (Early Years HLE) Measures

Measures of home learning environment were obtained from parents' responses at three time points: entry at study, KS1 and KS2. The indicators of the HLE in Early years were based on the frequency of specific activities involving the child, as reported by parents when children were recruited to the study during the pre-school period (i.e., teaching the child the alphabet, playing with letters and numbers, library visits, reading to the child, teaching the child songs or nursery rhymes). These measures were combined to form an overall Early Years HLE index with scores that could vary between 0 (very low Early Years HLE) and 49 (very high Early Years HLE).

When the overall HLE index was tested, it was found that the overall quality of the Early Years HLE remains a powerful predictor of better cognitive attainment at age 14, in secondary school. For all three attainment outcomes, only the two highest HLE categories were statistically significant (e.g., 25-32 and 33-45). For the top HLE category, the following effect sizes were obtained - English: ES_{Orig}=0.29; $ES_{Imputed}$=0.36, mathematics: ES_{Orig}=0.38; $ES_{Imputed}$=0.42 and science: ES_{Orig}=0.41; $ES_{Imputed}$=0.36 'net' of other individual pupil and family factors (see Figure 2.8, Figure 2.9 and Figure 2.10). These results suggest that the importance of the experiences related to the learning opportunities at home during the Early Years continues to remain high for later secondary school cognitive outcomes even at age 14.

Figure 2.8: The Net Effect of Early Years HLE on English Teacher Assessment Levels in Year 9

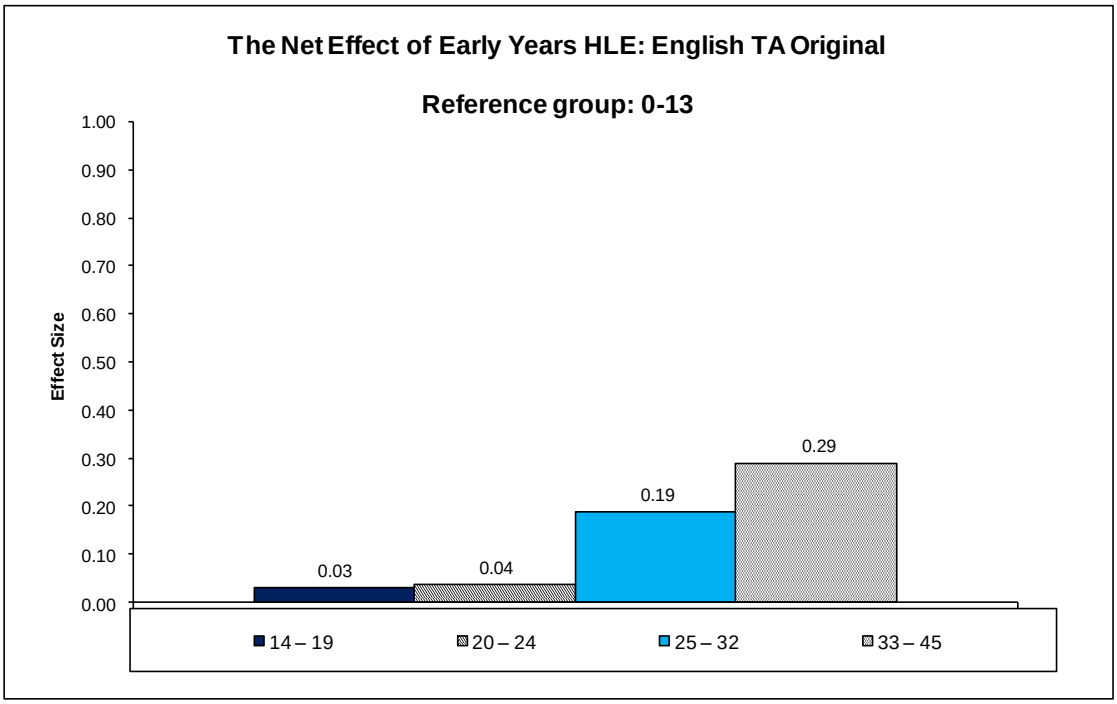


Figure 2.9: The Net Effect of Early Years HLE on Mathematics Teacher Assessment Levels in Year 9

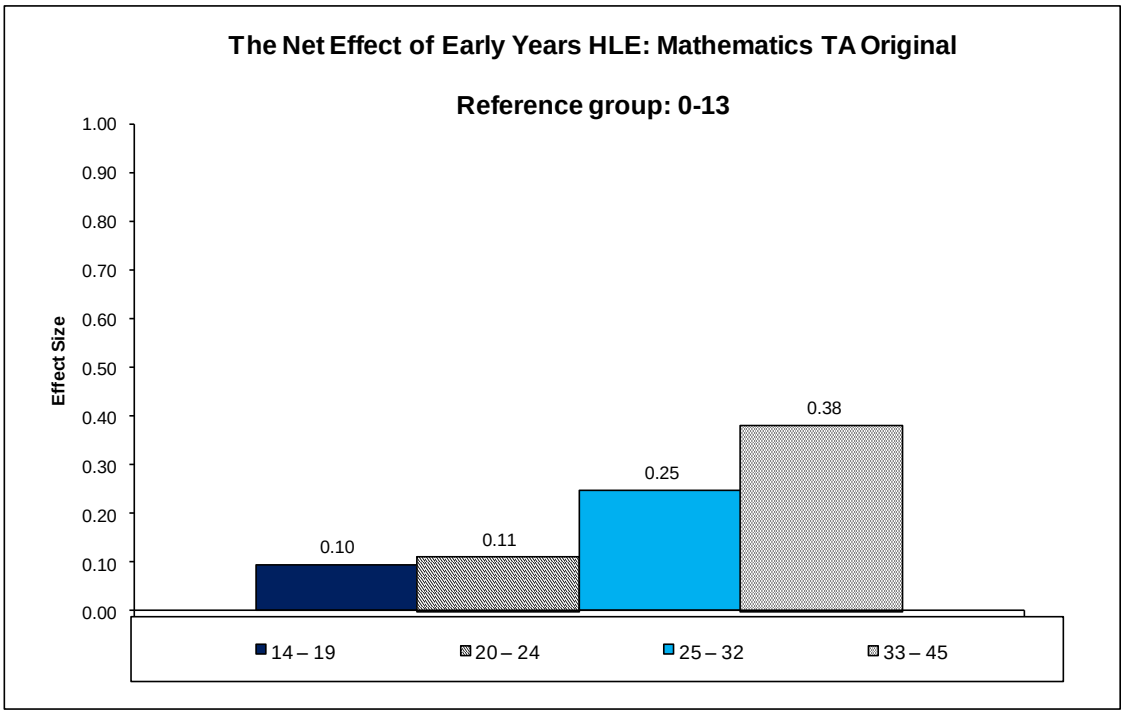
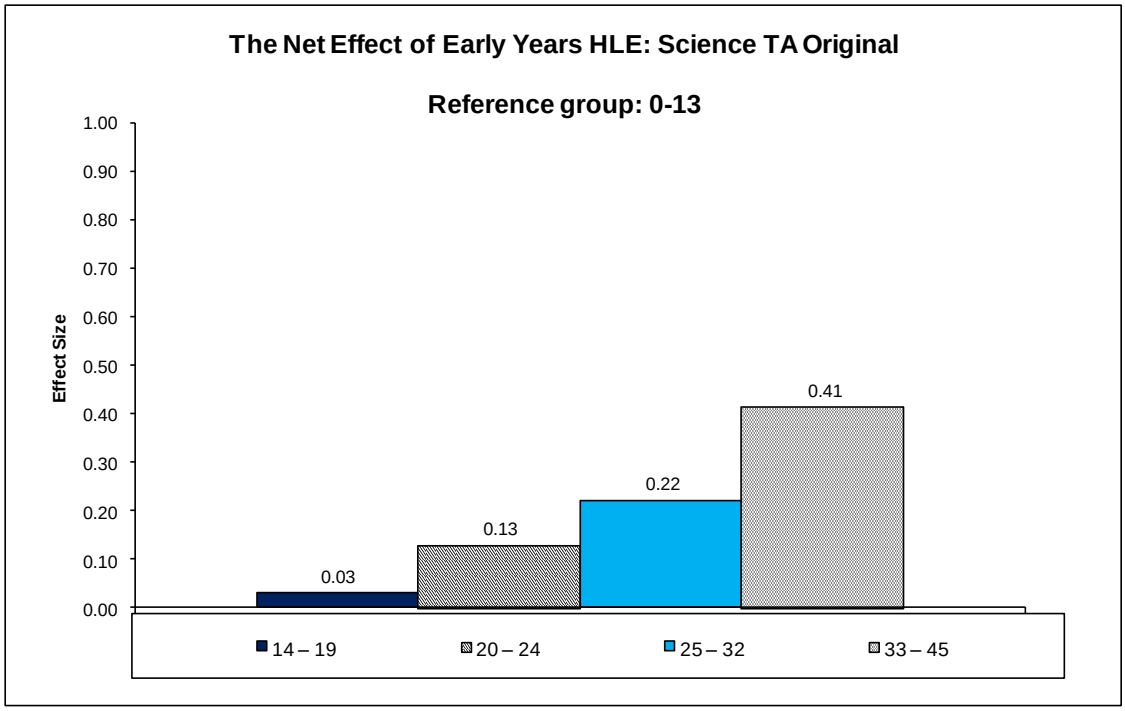


Figure 2.10: The Net Effect of Early Years HLE on Science Teacher Assessment Levels in Year 9



Key Stage 1 Home Learning Environment (KS1 HLE)

As the learning environment at home during the pre-school period was shown to have a strong impact on children's academic attainment during pre-school, parents were again surveyed during KS1 (age 6-7 years) about their interactions with their child at home via a parent questionnaire. They reported on activities such as the frequency of reading to/ with the child, taking the child out on educational visits, computing activities, sport activities, dance, etc. It should be noted that the KS1 HLE measures were collected by questionnaire survey rather than interview and thus the data may be slightly less reliable than the measure of Early Years HLE collected via face-to face-interviews.

The individual KS1 HLE measures have been aggregated to form four factors representing different parental activities during KS1: Home Computing, One-to-one Interaction, Expressive Play and Enrichment Outings (see Sammons, 2008a; 2008b). All four factors were tested in models that controlled for the individual pupil and family characteristics, but also for Early Years HLE. The latter remained the stronger predictor even when KS1 HLE measures were included.

For attainment in English and science, only the Enrichment Outings factor was statistically significant (English: ES_{Orig}=0.24; $ES_{Imputed}$=0.19; science: ES_{Orig}=0.15; $ES_{Imputed}$=0.09^{ns}). Both moderate and frequent outings during KS1 were associated with higher levels of TA in English in Year 9. Only moderate levels of outings during KS1 were associated with better outcome in science. None of the KS1 HLE factors were related to the Year 9 TA levels in mathematics.

These results are different from the ones obtained in Year 6, where the KS1 HLE One-to-one Interaction and Home Computing factors were significant predictors of attainment in English and mathematics. It is possible that certain learning activities (i.e., reading to a child, using the computer) from home during KS1 were more likely to influence the cognitive outcome during the same time period, rather than later outcome. However, the link with enrichment activities such as outings seems to have lasting effects on later cognitive attainment.

Key Stage 2 Home Learning Environment (KS2 HLE)

The home learning environment seems to be interestingly related to cognitive attainment, remaining an important predictor that needs to be continually investigated. At KS2 another questionnaire was sent to the parents who were asked to state their level of involvement in

different learning activities at home. The parents reported on activities such as the frequency of internet usage, taking the child out to physical activities and educational visits, computing activities, teaching the child different subjects.

Five KS2 HLE factors were extracted from the individual items: Educational Computing, Parent-Child Learning Processes, Parent-Child Reading Activities, Individual Child Activities and Computer Games (see Appendix 5). These factors were tested with respect to their influence on cognitive attainment at the end of Year 9. The models controlled for Early Years HLE and the statistically significant KS1 HLE specific factors.

Two of the KS2 HLE factors seemed to be important for cognitive attainment in Year 9: Educational Computing and Individual Activities. Education Computing was positively associated with the TA levels in English and mathematics. However, only the moderate levels of computer usage were associated with higher attainment in English (ES_{Orig}=0.19; $ES_{Imputed}$=0.15) and mathematics (ES_{Orig}=0.17; $ES_{Imputed}$=0.17) in Year 9, probably because just an optimal level of home computing is good for cognitive attainment. For attainment in science, the pupil's Individual Activities factor was statistically significant (ES_{Orig}=0.17; $ES_{Imputed}$=0.15). Only the moderate levels of Individual Activities during KS2 were associated with higher levels of TA in science in Year 9.

2.4. Neighbourhood 'Influence'

So far we have shown that individual pupil and family characteristics together with home learning environment measured at different time points continue to be very important predictors of pupils' academic attainment at age 14. In this section, we analyse whether a broader context like the neighbourhood environment has any influences on pupils' attainment in Year 9. Therefore, to the full contextualised models predicting cognitive outcomes multiple measures of neighbourhood environment were added. These measures were available either from census statistics or from the National Pupil Data (NPD) and consisted of the Index of Multiple Deprivation (IMD), percentage of White British citizens in the neighbourhood, level of crime, level of employment, percentage of residents with limiting long-term illness, the Income Deprivation Affecting Children Index (IDACI) and neighbourhood safety. The indicators were tested individually after control for individual pupil, family and HLE factors to avoid potential collinearity issues (see Table 2.10 for the correlations between different measures). The continuous measures of neighbourhood disadvantage were centred to the grand mean.

Level of employment and the percentage of residents with limiting long-term illness were features of the neighbourhood that were not significant predictors of the cognitive attainment at age 14. However, the other characteristics mentioned above were found to be significant predictors of cognitive outcome in secondary school.

Table 2.10: Correlations Between Different Measures of Neighbourhood Disadvantage (Original Data)

Neighbourhood Characteristics		IMD 2004	% of White British	Crime	Employment	% Limiting Long Term Illness	IDACI
IMD 2004	r	1	-.523**	.736**	.916**	.450**	.916**
	N	2994	2991	2991	2991	2991	2991
% of White British	r		1	-.406**	-.359**	.009	-.476**
	N		2998	2998	2998	2998	2998
Crime	r			1	.610**	.269**	.677**
	N			2998	2998	2998	2998
Employment	r				1	.513**	.843**
	N				2998	2998	2998
% Limiting Long-Term Illness	r					1	.422**
	N					2998	2998

**. Correlation is significant at the 0.01 level (2-tailed).

Index of Multiple Deprivation (IMD)

The first of the neighbourhood disadvantage measurements, IMD is a nationwide index combining weighted measures or levels of: crime, barriers to housing, living environment, education and skills training, health deprivation and disability, employment and income. The greater the IMD score, the greater the level of neighbourhood deprivation. The index is divided into Local Authority (LA) and Super Output Areas (SOA), where SOAs are defined as areas smaller than wards, frequently nested in wards, and of broadly consistent population size. For the purposes of analysis, the 2004 IMD scores were assigned to each child on the basis of their pre-school home address (using postcode) being used to identify the appropriate SOA (for further details of the IMD see Noble et al., 2004; 2008).

Results indicated that pupils' cognitive outcomes (especially English and science TA levels) were predicted significant by neighbourhood disadvantage as measured by IMD scores although the effect sizes were only small (see Table 2.11, Table 2.12 and Table 2.13). The higher the multiple deprivation index scores the lower the academic results in Year 9 (English: ES_{Orig}=-0.17; $ES_{Imputed}$=-0.18; science: ES_{Orig}=-0.14; $ES_{Imputed}$=-0.15). For mathematics, the IMD was significant only on the imputed data.

Table 2.11: Contextualised Models for English Teacher Assessment Levels in Year 9: IMD (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2457**				**2996**			
Number of schools	**531**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
IMD 2004 (continuous)	-0.004	0.001	-0.17	*	-0.004	0.001	-0.18	*
% Reduction school variance	79%				68%			
% Reduction pupil variance	25%				17%			
% Reduction total variance	38%				26%			

* p <0.05

Table 2.12: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: IMD (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
IMD 2004 (continuous)	-0.003	0.002	-0.09		-0.004	0.001	-0.12	*
% Reduction school variance	83%				78%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	29%				26%			

* p <0.05

Table 2.13: Contextualised Models for Science Teacher Assessment Levels in Year 9: IMD (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2459**				**2996**			
Number of schools	**532**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
IMD 2004 (continuous)	-0.003	0.001	-0.14	*	-0.004	0.001	-0.15	*
% Reduction school variance	79%				80%			
% Reduction pupil variance	13%				10%			
% Reduction total variance	29%				26%			

* p <0.05

Percentage of White British

The percentage of White British citizens in the neighbourhood was also a significant and negative predictor of pupils' cognitive attainment. A higher percentage of residents who are White British in the neighbourhood was a significant predictor of lower cognitive TA results in English (ES_{Orig}=-0.20; $ES_{Imputed}$=-0.15), mathematics (ES_{Orig}=-0.15; $ES_{Imputed}$=-0.08^{ns}) and science (ES_{Orig}=-0.18; $ES_{Imputed}$=-0.10^{ns}) (see Table 2.14,Table 2.15 and Table 2.16).

Table 2.14: Contextualised Models for English Teacher Assessment Levels in Year 9: Percentage White British (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**533**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
% White British (continuous)	-0.003	0.001	-0.20	*	-0.003	0.001	-0.15	*
% Reduction school variance	80%				70%			
% Reduction pupil variance	24%				16%			
% Reduction total variance	38%				30%			

* p <0.05

Table 2.15: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Percentage White British (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
% White British (continuous)	-0.004	0.002	-0.15	*	-0.002	0.002	-0.08	
% Reduction school variance	83%				79%			
% Reduction pupil variance	17%				11%			
% Reduction total variance	29%				26%			

* p <0.05

Table 2.16: Contextualised Models for Science Teacher Assessment Levels in Year 9: Percentage White British (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
% White British (continuous)	-0.003	0.001	-0.18	*	-0.002	0.001	-0.10	
% Reduction school variance	89%				80%			
% Reduction pupil variance	16%				9%			
% Reduction total variance	33%				26%			

* p <0.05

Level of Crime

Similarly, the level of crime in a neighbourhood was a significant predictor of cognitive outcomes in Year 9. A neighbourhood characterised by a higher level of crime negatively influenced the academic attainment in English (ES_{Orig}=-0.17; $ES_{Imputed}$=-0.12) and science TA results (ES_{Orig}=-0.14; $ES_{Imputed}$=-0.14). The associations of crime levels with results in mathematics were statistically significant only for the imputed data (ES_{Orig}=-0.08^{ns}; $ES_{Imputed}$=-0.10) (see Table 2.18).

Table 2.17: Contextualised Models for English Teacher Assessment Levels in Year 9: Crime (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**533**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Crime (continuous)	-0.08	0.02	-0.17	*	-0.06	0.03	-0.12	*
% Reduction school variance	79%				68%			
% Reduction pupil variance	25%				17%			
% Reduction total variance	38%				30%			

* p <0.05

Table 2.18: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Crime (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Crime (continuous)	-0.05	0.03	-0.08		-0.07	0.03	-0.10	*
% Reduction school variance	83%				78%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	29%				26%			

* p <0.05

Table 2.19: Contextualised Models for Science Teacher Assessment Levels in Year 9: Crime (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Crime (continuous)	-0.07	0.03	-0.14	*	-0.07	0.02	-0.14	*
% Reduction school variance	89%				81%			
% Reduction pupil variance	17%				10%			
% Reduction total variance	34%				26%			

* p <0.05

Income Deprivation Affecting Children Index

Income Deprivation Affecting Children Index (IDACI) represents the percentage of children in each SOA that live in families that are income deprived. The overall IMD does not include the IDACI as the children are already captured in the Income Deprivation Domain.

Similarly to results for the IMD, IDACI is a negative predictor of pupils' cognitive outcomes in Year 9 (see Table 2.20, Table 2.21 and Table 2.22). Children who had grown up in a neighbourhood characterised by economically deprived families tend to do worse academically in Year 9, after control for their own family characteristics including family SES and income. Thus, the effect sizes of IDACI for English TA levels are ES_{Orig}=-0.16 and $ES_{Imputed}$=-0.14, while for science TA these are ES_{Orig}=-0.15; $ES_{Imputed}$=-0.14). The associations of IDACI with results in mathematics are statistically significant only for the imputed data (ES_{Orig}=-0.10^{ns}; $ES_{Imputed}$=-0.11).

Table 2.20: Contextualised Models for English Teacher Assessment Levels in Year 9: IDACI (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**533**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
IDACI (continuous)	-0.32	0.11	-0.16	*	-0.29	0.11	-0.14	*
% Reduction school variance	79%				68%			
% Reduction pupil variance	25%				17%			
% Reduction total variance	38%				30%			

* p <0.05

Table 2.21: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: IDACI (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2533**				**2996**			
Number of schools	**582**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
IDACI (continuous)	-0.28	0.15	-0.10		-0.30	0.15	-0.11	*
% Reduction school variance	83%				79%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	29%				26%			

* p <0.05

Table 2.22: Contextualised Models for Science Teacher Assessment Levels in Year 9: IDACI (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
IDACI (continuous)	-0.33	0.12	-0.15	*	-0.31	0.12	-0.14	*
% Reduction school variance	88%				81%			
% Reduction pupil variance	17%				10%			
% Reduction total variance	34%				26%			

* p <0.05

Neighbourhood Safety

The indicator of neighbourhood safety was based on parents' own perceptions derived from the KS1 parent questionnaire. The results of the relationships between the views on neighbourhood safety and pupils' later academic outcome are presented in Table 2.23 and Table 2.24. These findings indicated that only for mathematics and science, a high level of neighbourhood safety was a significant predictor of higher academic TA levels, when compared to low safety (mathematics: ES_{Orig}=0.13; $ES_{Imputed}$=0.13^{ns}; science: ES_{Orig}=0.18; $ES_{Imputed}$=0.17). English TA results in Year 9 were not significantly related to the level of neighbourhood safety.

Table 2.23: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Neighbourhood Safety (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Neighbourhood safety (compared to low safety)								
Medium low safety	0.06	0.07	0.05		0.10	0.08	0.09	
Medium high safety	0.05	0.08	0.05		0.09	0.08	0.08	
High safety	0.15	0.08	0.13	*	0.15	0.08	0.13	
% Reduction school variance	83%				79%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	29%				26%			

* p <0.05

Table 2.24: Contextualised Models for Science Teacher Assessment Levels in Year 9: Neighbourhood Safety (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Neighbourhood safety (compared to low safety)								
Medium low safety	0.03	0.06	0.04		0.10	0.06	0.11	
Medium high safety	0.10	0.06	0.11		0.12	0.06	0.12	*
High safety	0.16	0.06	0.18	*	0.16	0.06	0.17	*
% Reduction school variance	89%				81%			
% Reduction pupil variance	16%				09%			
% Reduction total variance	34%				26%			

* p <0.05

Overall, it was found that specific features of the neighbourhood where children lived while at pre-school age continue to have influence on their academic outcomes in secondary school. It seems that some of these influences are stronger in Year 9 than in Year 6 (where for example, IMD scores failed to reach significant levels in influencing English and mathematics KS2 National Assessment test scores). This could be attributed to the fact that teachers might be more likely 'biased' by the pupils' family and broader social context when assessing their cognitive performance (Gibbons & Chevalier, 2008; Harlen, 2005). Evidence of biases captured by the TA levels was also found in previous analyses for cohort 1 and 2 (see Sammons et al., 2009). These analyses showed the TA levels accentuated existing social disparities when controlling for actual test performance. More concrete, TA levels exaggerated the advantage of girls in English, the underachievement of young people with prior behaviour problems and the underachievement of the young people from poorer families as compared with those from high income families.

Previous research has indicated the control for neighbourhood disadvantage is essential as this variable proved to be a significant predictor of attainment and progress in English National Assessment test scores. Such measures (e.g., IMD) were also included in the DfE CVA models to control for the possible influences of the neighbourhood in evaluating school outcome.

These data also confirm that neighbourhood effects are statistically significant in shaping KS3 results. In primary school the EPPE research found that neighbourhood measures were not statistically significant predictors of children's attainment when the early influence of home learning was taken into account. However, even when Early Years HLE was controlled in these models, it was shown that neighbourhood disadvantage was a significant predictor, although relatively weak, for the same pupils at age 14. This suggests that the neighbourhood context became more important in shaping pupils' educational outcomes as they grow older and this is likely to reflect pupils' greater involvement in activities outside the home and with their peer group in the local area as they move into early adolescence.

3. Pupils' Cognitive Attainment at the End of Year 9 in Secondary School: The Impact of Pre-school, Primary and Secondary School

The contextualised models presented in the previous section emphasised the importance of the individual pupil and family background as well as the specific characteristics of the immediate social context in shaping pupils' cognitive attainment in Year 9. We have clear evidence that the range of individual pupil, parent and HLE factors continue to show a both statistically and educationally significant relationship with cognitive outcomes in Year 9, echoing earlier outcomes at the end of primary school or at the end of Year 2. The pattern of findings is in line with other studies about academic achievement in secondary schools (Sammons, 1995).

In order to further investigate whether there are any continuing effects of pre-school attendance, quality or effectiveness on later cognitive attainment, it is important to take into account the individual background. Similar control is needed when examining the potential impact of primary or secondary school effectiveness on cognitive results. One of the most important findings of the EPPE study was that the experiences in various pre-school centres had a statistically significant effect on cognitive attainment measured at different time points, up to age 11. The consistency and the persistence of the pre-school effects on academic attainment over the time lead to an important aim of the Year 9 analyses, which was to establish whether there is evidence of any continuing pre-school influence in secondary school at age of 14 years. Additionally, we were interested whether primary school has an influential impact on pupils' cognitive attainment and progress in secondary school. Similarly, we expect that the characteristics of secondary school attended could possibly influence the level of pupils' attainment. Another aim is to investigate the combined influences of pre-, primary and secondary school on young pupils' cognitive attainment in Year 9.

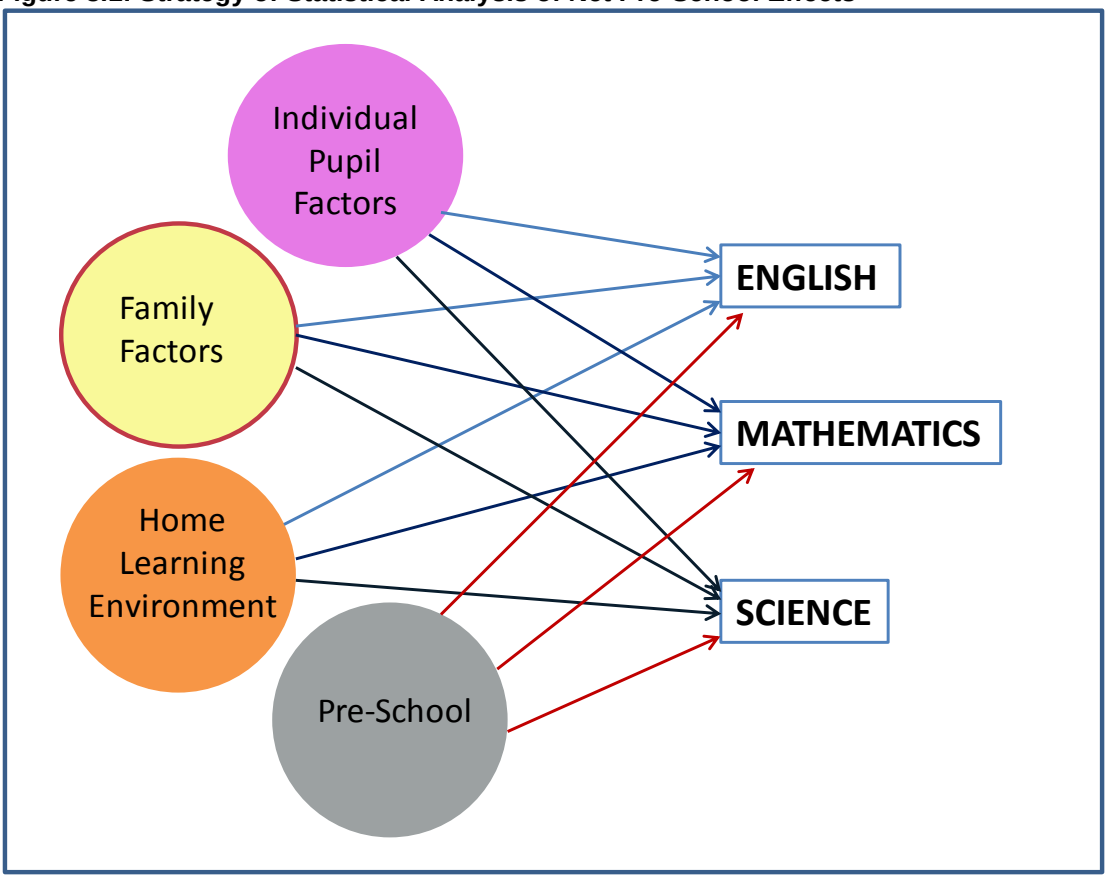
A further major interest of the analyses was to explore whether the pre-school experience, primary and secondary school effectiveness have different influences on different groups of pupils such as pupils of less qualified parents or with different levels of the HLE (the concept of differential effects or benefits).

This section presents results of contextualized multilevel modelling analyses that have been used to investigate the described research questions.

3.1. The Impact of Pre-school Experience on Year 9 Attainment

Three aspects of pre-school experience were considered to investigate any continuing effect on Year 9 cognitive attainment: attendance at a pre-school centre compared to no pre-school, pre-school quality and pre-school effectiveness. Also, the combined impact of Early Years HLE and pre-school experience was investigated (see Figure 3.1 for an illustration of the analysis strategy). The findings from these complex analyses focus on the presentation of effect sizes.

Figure 3.1: Strategy of Statistical Analysis of Net Pre-School Effects



3.1.1. The Continuing Impact of Pre-School Attendance at Later KS3 Attainment

There is no evidence of continuing pre-school attendance or pre-school quality effects on students' later English attainment levels as measured by TA levels.

The most basic indicator of the pre-school experiences proved to be significantly associated with attainment in mathematics and science, after controlling for individual and family characteristics, Early Years HLE, KS1 and KS2 HLE. The effect sizes are presented in Table 3.1 and Table 3.2.

Attending a pre-school continues to have a positive relationship with mathematics (ES_{Orig}=0.26; $ES_{Imputed}$=0.25) and science TA levels (ES_{Orig}=0.22; $ES_{Imputed}$=0.22). The same effect size of pre-school attendance was found for mathematics test scores in Year 6 (ES=0.26; Sammons, 2008a).

Table 3.1: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Attendance (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school (compared to no pre-school)	0.30	0.10	0.26	*	0.30	0.10	0.25	*
% Reduction school variance	83%				78%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	29%				26%			

* p <0.05

Table 3.2: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Attendance (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school (compared to no pre-school)	0.20	0.08	0.22	*	0.21	0.08	0.22	*
% Reduction school variance	89%				81%			
% Reduction pupil variance	16%				10%			
% Reduction total variance	34%				26%			

* p <0.05

3.1.2. The Continuing Impact of Pre-school Centre Quality at Later KS3 Attainment

Pre-school quality was measured with two different scales: ECERS-R and ECERS-E (Sylva et al., 1999; 2006). Previous report had found that ECERS-E, which focuses on the education aspects of pre-school, had the most consistent effects upon cognitive attainment. The original sample was divided into groups of pupils whose pre-school experience could be classified as ranging from no quality (i.e., the 'home' group) through low, medium and high quality, based on individual pre-school centres' ECERS-E scores. The distribution of ECERS-E groups in the present sample was the following: no pre-school (10%) low quality (14%), medium quality (54%) and high quality (22%).

As with earlier time points showed a positive impact of higher quality pre-school provision on cognitive outcomes, the results from Year 9 indicated that the "home" group significantly differed in their cognitive attainment from pupils attending medium or high quality pre-school settings. For the attainment in mathematics, even a lower quality setting was better than no-pre-school (ES_{Orig}=0.22; $ES_{Imputed}$=0.20). Additionally, the better the pre-school's quality the higher the pupils' later outcomes measured by KS3 TA levels in mathematics (see Table 3.3).

In terms of attainment in science, only the experience of medium and high quality pre-school provision showed a statistical significant positive impact at the end of Year 9 when compared to the experience of staying at home. The ES for both types of provision were very similar (Medium quality: ES_{Orig}=0.23; $ES_{Imputed}$=0.23; High quality: ES_{Orig}=0.22; $ES_{Imputed}$=0.23) (see Table 3.4).

Table 3.3: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Quality Measured by ECERS-E (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Quality (compared to no pre-school)								
Low quality	0.25	0.11	0.22	*	0.23	0.11	0.20	*
Medium quality	0.31	0.10	0.27	*	0.31	0.10	0.27	*
High quality	0.32	0.11	0.28	*	0.31	0.11	0.26	*
% Reduction school variance	83%				78%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	29%				26%			

* p <0.05

Table 3.4: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Quality Measured by ECERS-E (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Quality (compared to no pre-school)								
Low quality	0.16	0.09	0.17		0.17	0.09	0.18	
Medium quality	0.21	0.08	0.23	*	0.22	0.08	0.23	*
High quality	0.20	0.09	0.22	*	0.22	0.09	0.23	*
% Reduction school variance	89%				81%			
% Reduction pupil variance	16%				09%			
% Reduction total variance	34%				26%			

* p <0.05

We can conclude that for both mathematics and science attending a medium to high quality pre-school was associated with significantly enhanced attainment compared to no pre-school, but in contrast to findings in primary school, there were no longer significant differences in English results at age 14.

3.1.3. The Continuing Impact of Pre-school Centre Effectiveness at Later KS3 Attainment

Measures of pre-school centre effectiveness were calculated separately for Pre-Reading and Early Number Concepts for all pre-school centres in the study. These measures were the residuals from multilevel value added models predicting cognitive attainment (at the end of pre-school) of pupils who attended a pre-school centre, controlling for their prior attainment at entry to the study and background influences. Pre-schools where children made more progress than predicted were more effective than those where children made less progress that predicted (on basis of prior attainment and background characteristics) (Sammons et al., 2002). Measures of pre-school centre effectiveness proved to be significant predictors of pupils' subsequent cognitive attainment in primary school. Therefore, it was expected that these effects might continue to shape pupils' attainment later on in KS3 as well. In order to establish whether the effectiveness of the pre-school setting attended showed any continuing impact on the attainment at KS3, further multilevel

analyses were conducted on the Year 9 English, mathematics and science outcomes. In these analyses, pre-school centre effectiveness in promoting young children's progress in Pre-Reading was tested as a potential predictor for English attainment in Year 9. Pre-school centre effectiveness, in terms of promoting young children's progress in Early Number Concepts, was tested as a predictor for later mathematics and science attainment in Year 9.

Table 3.5, Table 3.6 and Table 3.7 show that after controlling for individual pupil, family and HLE influences, the measures of centre effectiveness still showed a statistically significant positive 'net' impact on pupils' attainment in English, mathematics and science at Year 9.

Regarding the Year 9 English attainment, pupils who had previously attended a highly effective pre-school continued to show a benefit in terms of significantly higher attainment than pupils who had not attended any pre-school (ES_{Orig}=0.20; $ES_{Imputed}$=0.16^{ns}).

Table 3.5: Contextualised Models for English Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Pre-Reading) (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**533**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness Pre-reading (compared to no pre-school)								
Low effectiveness	0.06	0.08	0.07		0.07	0.08	0.08	
Medium effectiveness	0.14	0.07	0.17		0.09	0.08	0.11	
High effectiveness	0.16	0.08	0.20	*	0.14	0.08	0.16	
% Reduction school variance	81%				70%			
% Reduction pupil variance	24%				16%			
% Reduction total variance	38%				30%			

* p <0.05

The three categories of pre-school effectiveness predicted better attainment in mathematics; pupils who went to low, medium or high effective pre-schools had significantly higher TA levels than pupils who had not attended a pre-school (see Table 3.6). However, there was no clear trend differentiating low and high effective pre-schools.

Table 3.6: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Early Number Concepts) (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness Early Number Concepts (compared to no pre-school)								
Low effectiveness	0.35	0.12	0.30	*	0.33	0.12	0.28	*
Medium effectiveness	0.26	0.10	0.22	*	0.26	0.10	0.22	*
High effectiveness	0.41	0.11	0.36	*	0.39	0.11	0.33	*
% Reduction school variance	84%				78%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	30%				26%			

* p <0.05

Similarly, pupils who went to medium or high effective pre-schools (in terms of early number concepts) had significantly higher attainment in science TA levels in Year 9 than those who had not attended a pre-school (see Table 3.7). Here there was a trend indicating that only a medium or a

high effective pre-school (in terms of promoting early number concepts) predicted better outcomes. The ES for high effective pre-school was similar in size to the FSM measure in science.

Table 3.7: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Early Number Concepts) (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness Early Number Concepts (compared to no pre-school)								
Low effectiveness	0.15	0.09	0.16		0.14	0.09	0.15	
Medium effectiveness	0.18	0.08	0.19	*	0.20	0.08	0.21	*
High effectiveness	0.30	0.09	0.33	*	0.29	0.09	0.30	*
% Reduction school variance	90%				81%			
% Reduction pupil variance	16%				10%			
% Reduction total variance	34%				26%			

* p <0.05

3.1.4. Different Pre-school Effects for Different Groups of Pupils

A topic of particular interest is whether pre-school experience has different effects on particular groups of pupils, specifically those more vulnerable to risk of low attainment. In terms of risk, key features were identified as having considerable impact on attainment: the pupils' Early Years HLE and the level of their parents' highest qualification. Each of these was considered in relation to pre-school attendance, pre-school quality, and pre-school effectiveness.

The Combined Impact of Pre-school Experience and Early Years Home Learning Environment (HLE)

Given that the described analyses have already demonstrated modest effects for the quality and effectiveness of pre-school experience but strong effects for the Early Years HLE on later academic attainment, their joint effects were investigated. For this analysis, the Early Years HLE index was regrouped into three categories representing low, medium and high Early Years HLE. Next, combined terms were created between Early Years HLE and pre-school attendance, pre-school quality (measured by ECERS-E) and pre-school effectiveness. These joint measures were then entered in the contextualised models that controlled for individual and family characteristics.

Early Years HLE and Pre-school Attendance

Table 3.8 shows the combined effects of Early Years HLE and pre-school attendance (yes/no) on the original and imputed English TA levels in Year 9. The reference group for these analyses was the group of pupils with no pre-school and low Early Years HLE.

Figure 3.2 shows, for English, the positive effect of a medium and high quality Early Years HLE for the 'home' group. Pupils with no pre-school but who scored high on the Early Years HLE index showed higher levels of attainment in English (ES_{Orig}=0.48; $ES_{Imputed}$=0.42) than pupils with no pre-school but with low Early Years HLE.

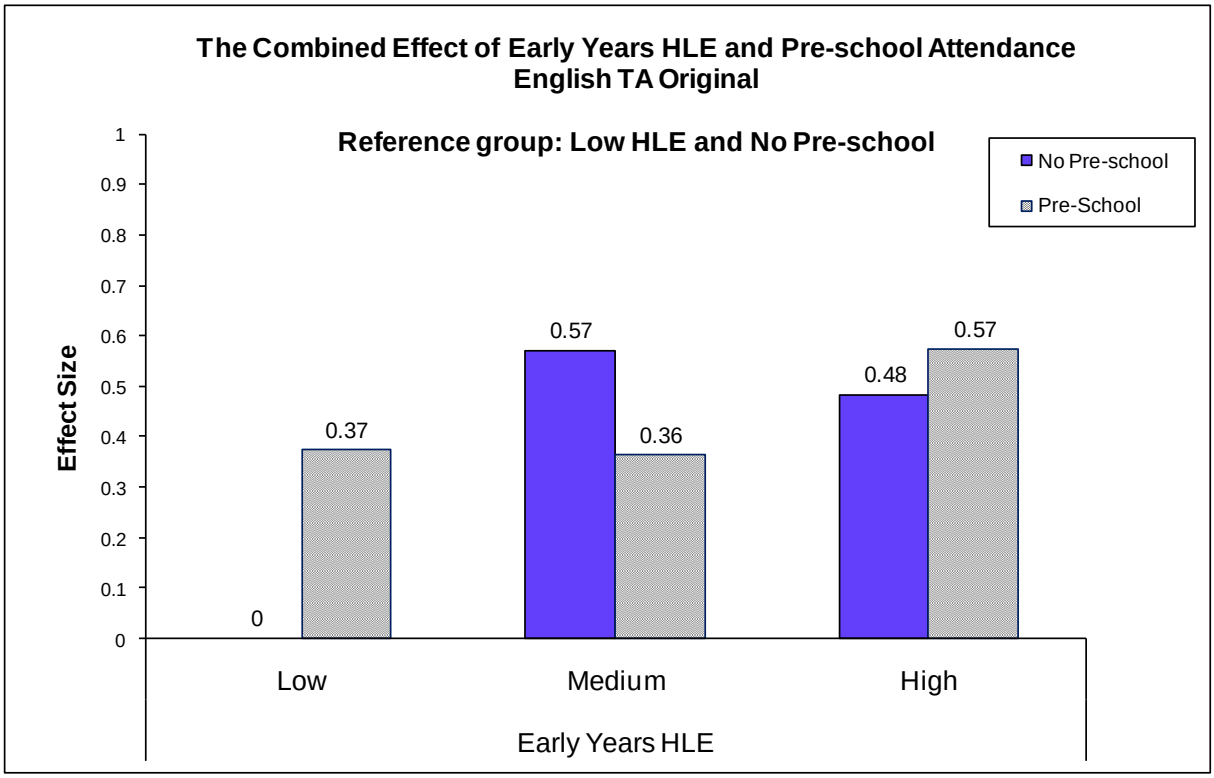
However, attending a pre-school was especially beneficial for those who did not experience a good Early Years HLE. These pupils performed significantly better that those with similar low levels of HLE but no pre-school (ES_{Orig}=0.37; $ES_{Imputed}$=0.29). The greatest advantage in later English attainment was for the pupils who had attended a pre-school and also had high Early Years HLE (ES_{Orig}=0.57; $ES_{Imputed}$=0.49).

Table 3.8: Contextualised Models for English Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Attendance Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2479**				**3000**			
Number of schools	**576**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Attendance (compared to No Pre-school and Low HLE)								
No pre-school, Medium HLE	0.48	0.15	0.57	*	0.29	0.15	0.34	
No pre-school, High HLE	0.41	0.15	0.48	*	0.36	0.15	0.42	*
Pre-school, Low HLE	0.32	0.11	0.37	*	0.25	0.11	0.29	*
Pre-school, Medium HLE	0.31	0.11	0.36	*	0.25	0.11	0.29	*
Pre-school, High HLE	0.48	0.11	0.57	*	0.42	0.11	0.49	*
% Reduction school variance	69%				67%			
% Reduction pupil variance	20%				16%			
% Reduction total variance	32%				29%			

* p <0.05

Figure 3.2: The Combined Impact of Early Years HLE and Pre-school Attendance on English Teacher Assessment Levels in Year 9



For mathematics and science the pattern of results differed slightly from the results in English (see Table 3.9 and Table 3.10). Figure 3.3 and Figure 3.4 illustrate that the Early Years HLE in combination with pre-school attendance had a strong positive influence on mathematics and science TA levels in Year 9, when controlling for other background factors such as family SES or qualification of parents, although the effects were largely driven by HLE.

Later attainment in mathematics and science improved significantly for pupils with a low Early Years HLE who had attended a pre-school (mathematics: ES_{Orig}=0.56; $ES_{Imputed}$=0.46; science: ES_{Orig}=0.48; $ES_{Imputed}$=0.40). Pre-school attendance did not continue to make a difference for Year

9 attainment when pupils experienced a medium Early Years HLE (see Figure 3.3 and Figure 3.4). Nevertheless, the advantage of a high Early Years HLE was increased even more by pre-school attendance (mathematics: ES_{Orig}=0.74; $ES_{Imputed}$=0.65; science: ES_{Orig}=0.71; $ES_{Imputed}$=0.61).

Taken together the results support the view that pupils with low Early Years HLE but who had previously attended a pre-school got better results in Year 9 than those with similar level of HLE and no pre-school, when controlling for all other individual and family factors. The continued impact of pre-school for medium Early Years HLE was insignificant, and for high Early Years HLE, the pre-school effect was only weak but statistically significant.

Table 3.9: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Attendance Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2493**				**3000**			
Number of schools	**579**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Attendance (compared to No Pre-school and Low HLE)								
No pre-school, Medium HLE	0.64	0.20	0.55	*	0.47	0.21	0.40	*
No pre-school, High HLE	0.66	0.20	0.57	*	0.58	0.20	0.50	*
Pre-school, Low HLE	0.65	0.14	0.56	*	0.54	0.14	0.46	*
Pre-school, Medium HLE	0.65	0.15	0.56	*	0.53	0.15	0.46	*
Pre-school, High HLE	0.86	0.15	0.74	*	0.76	0.14	0.65	*
% Reduction school variance	75%				76%			
% Reduction pupil variance	15%				12%			
% Reduction total variance	26%				25%			

* p <0.05

Figure 3.3: The Combined Impact of Early Years HLE and Pre-school Attendance on Mathematics Teacher Assessment Levels in Year 9

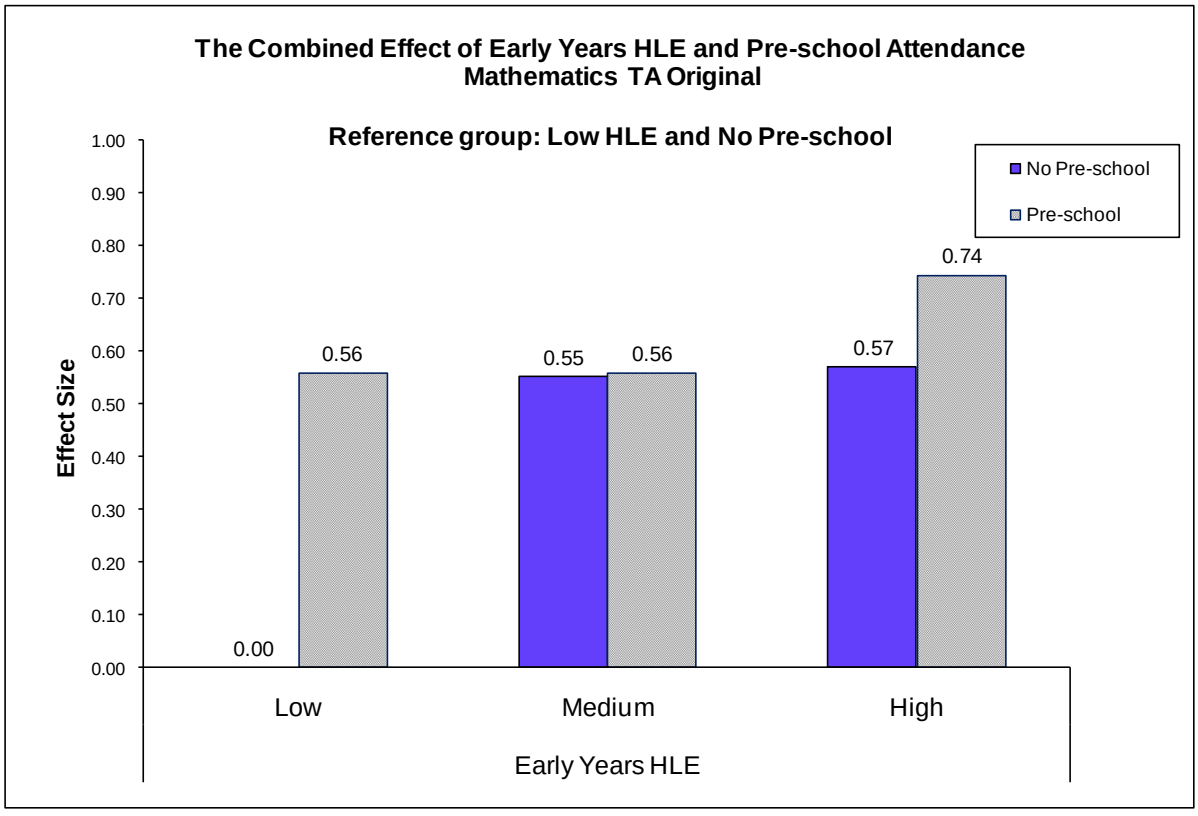
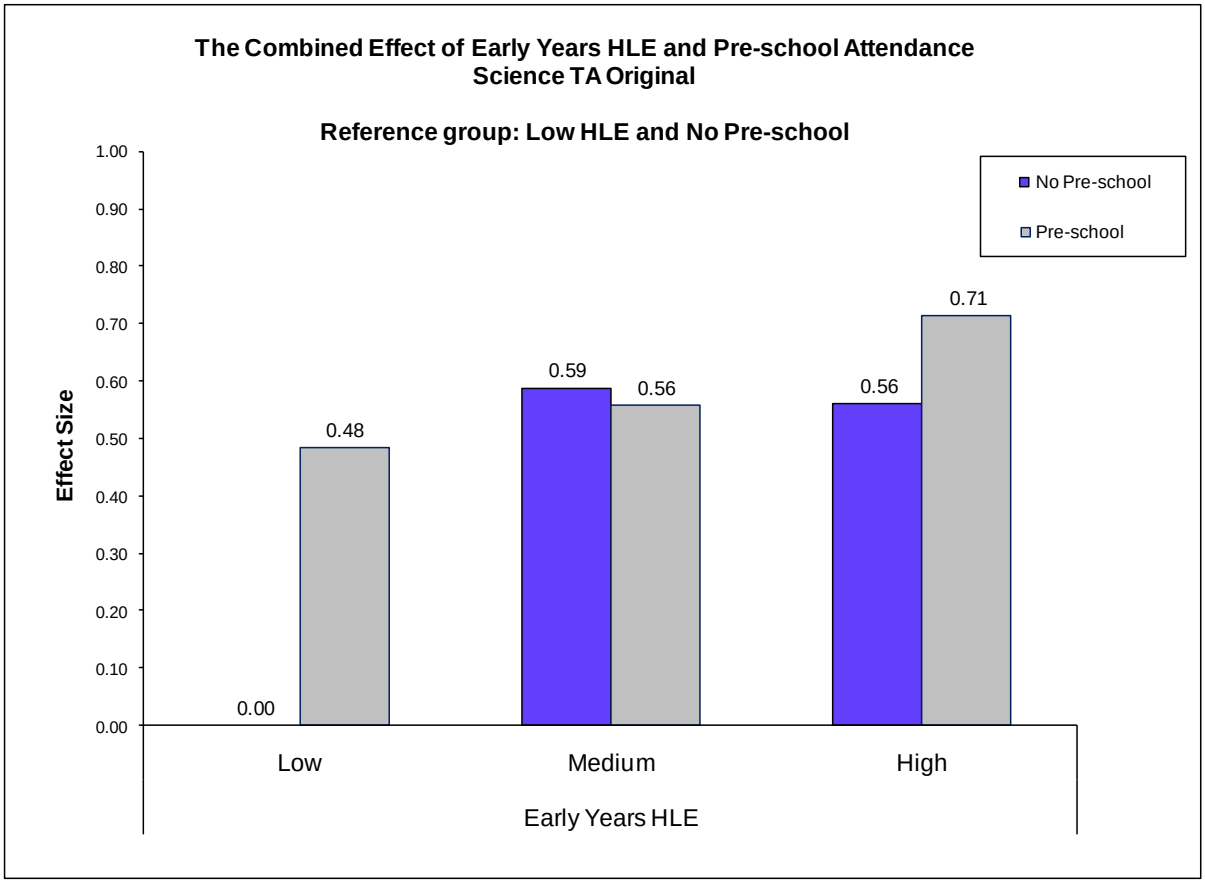


Table 3.10: Contextualised Models for Science Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Attendance Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2480**				**3000**			
Number of schools	**578**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Attendance (compared to No Pre-school and Low HLE)								
No pre-school, Medium HLE	0.54	0.16	0.59	*	0.39	0.16	0.41	*
No pre-school, High HLE	0.52	0.16	0.56	*	0.43	0.16	0.45	*
Pre-school, Low HLE	0.45	0.11	0.48	*	0.38	0.12	0.40	*
Pre-school, Medium HLE	0.52	0.12	0.56	*	0.43	0.12	0.45	*
Pre-school, High HLE	0.66	0.12	0.71	*	0.58	0.12	0.61	*
% Reduction school variance	79%				76%			
% Reduction pupil variance	13%				10%			
% Reduction total variance	29%				25%			

* p <0.05

Figure 3.4: The Combined Impact of Early Years HLE and Pre-school Attendance on Science Teacher Assessment Levels in Year 9



Early Years HLE and the Quality of the Pre-school

As previous analyses showed the effects of pre-school remain evident in Year 9 even when considering just simple attendance. Further analyses were conducted to investigate whether the quality of the pre-school combined with Early Years HLE predicts significantly the later attainment in Year 9. The results gives us further insight into the way Early Years HLE and pre-school may interact in influencing pupils' cognitive attainment in the longer term. Similarly to the previous analyses, the reference group was the 'no pre-school and low Early Years HLE' group. Results for

English, mathematics and science TA levels were reported in terms of effect sizes (see Table 3.11-Table 3.13).

Figure 3.5 shows the results for English TA levels and indicates that pupils with low Early Years HLE gained similar advantages from attending pre-school regardless of quality (ES_{Orig} between 0.33-0.43; $ES_{Imputed}$ between 0.25-0.36). Pre-school attendance did not improve the later attainment for those with medium level of Early Years HLE (when compared within the HLE group). Also pupils with medium Early Years HLE performed similarly regardless of pre-school and worse than those who had not attended a pre-school (Medium HLE and No pre-school: ES_{Orig}=0.57; $ES_{Imputed}$=0.33^{ns}).

High Early Years HLE combined with medium or high quality pre-schools were found to have the strongest positive long term benefits in English TA at the end of Year 9 (Medium Quality: ES_{Orig}=0.61; $ES_{Imputed}$=0.52; High Quality: ES_{Orig}=0.55; $ES_{Imputed}$=0.47). The pupils who had not attended any pre-school benefited from having a high Early Years HLE (ES_{Orig}=0.49; $ES_{Imputed}$=0.42). However, this effect was not as large as the one found for pupils with medium Early Years HLE (ES_{Orig}=0.57; $ES_{Imputed}$=0.33^{ns}).

For pupils who had attended a low quality pre-school, those with high Early Years HLE (ES_{Orig}=0.45; $ES_{Imputed}$=0.36) were doing better in terms of English TA levels than those with medium Early Years HLE (ES_{Orig}=0.27^{ns}; $ES_{Imputed}$=0.22^{ns}).

These results show similar patterns as the ones found for English National Assessment test scores in Year 6 (see Sammons et al., 2008a) underlining the fact that the quality of Early Years HLE continues to remain important in predicting English attainment in Year 9. However, the impact of the quality of pre-school experience is no longer clearly discerned, the main long-term difference appears to be related to attending pre-school for low HLE pupils.

Table 3.11: Contextualised Models for English Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Quality (ECERS-E) Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2479**				**3000**			
Number of schools	**576**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Quality (compared to No Pre-school and Low HLE)								
Low quality, Low HLE	0.36	0.13	0.43	*	0.26	0.14	0.31	
Medium quality, Low HLE	0.28	0.11	0.33	*	0.22	0.11	0.25	
High quality, Low HLE	0.37	0.12	0.43	*	0.31	0.12	0.36	*
No pre-school, Medium HLE	0.48	0.15	0.57	*	0.29	0.15	0.33	
Low quality, Medium HLE	0.23	0.14	0.27		0.19	0.14	0.22	
Medium quality, Medium HLE	0.33	0.11	0.39	*	0.26	0.12	0.31	*
High quality, Medium HLE	0.30	0.13	0.36	*	0.24	0.13	0.28	*
No pre-school, High HLE	0.41	0.15	0.49	*	0.36	0.15	0.42	*
Low quality, High HLE	0.38	0.13	0.45	*	0.31	0.13	0.36	*
Medium quality, High HLE	0.52	0.11	0.61	*	0.45	0.11	0.52	*
High quality, High HLE	0.47	0.12	0.55	*	0.41	0.12	0.47	*
% Reduction school variance	70%				68%			
% Reduction pupil variance	20%				16%			
% Reduction total variance	32%				29%			

* p <0.05

Figure 3.5: The Combined Impact of Early Years HLE and Pre-school Quality (ECERS-E) on English Teacher Assessment Levels in Year 9

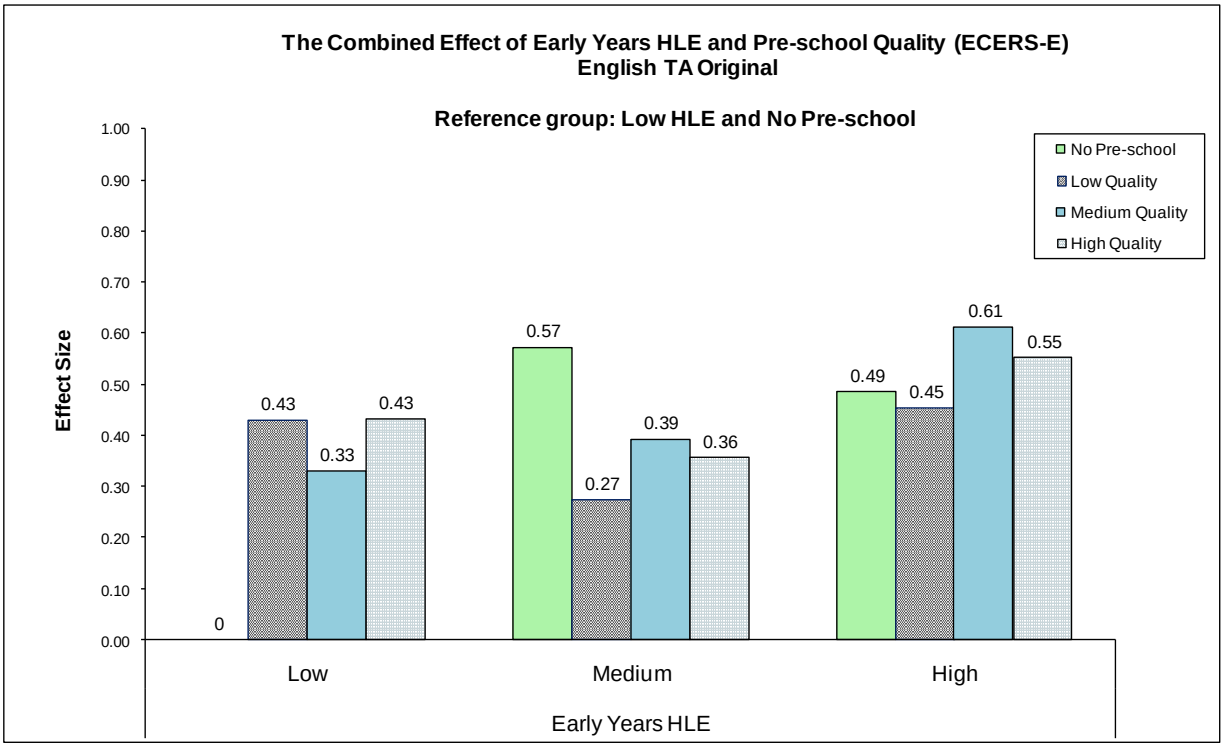


Figure 3.6 shows that pre-school quality together with Early Years HLE had positive effects for mathematics TA levels in Year 9. Pupils with low Early Years HLE obtained better results if they had previously attended a high quality pre-school (ES_{Orig}=0.66; $ES_{Imputed}$=0.56) when compared to 'no pre-school and low HLE'. As shown for English, pupils with medium Early Years HLE had similar levels of attainment in mathematics regardless of the pre-school's quality. However, pupils with medium Early Years HLE who had not attended pre-school performed significantly better than pupils who stayed at home and experienced low Early Years HLE (ES_{Orig}=0.55; $ES_{Imputed}$=0.40).

In contrast, high Early Years HLE pupils gained greater benefits from attending a medium and high quality pre-school for later mathematics results (Medium Quality: ES_{Orig}=0.79; $ES_{Imputed}$=0.68; High Quality: ES_{Orig}=0.68; $ES_{Imputed}$=0.62) than pupils with low Early Years HLE and no pre-school. The impact of the medium quality pre-school was larger for pupils with high Early Years HLE (ES_{Orig}=0.79; $ES_{Imputed}$=0.68) than for pupils with low Early Years HLE (ES_{Orig}=0.51; $ES_{Imputed}$=0.43).

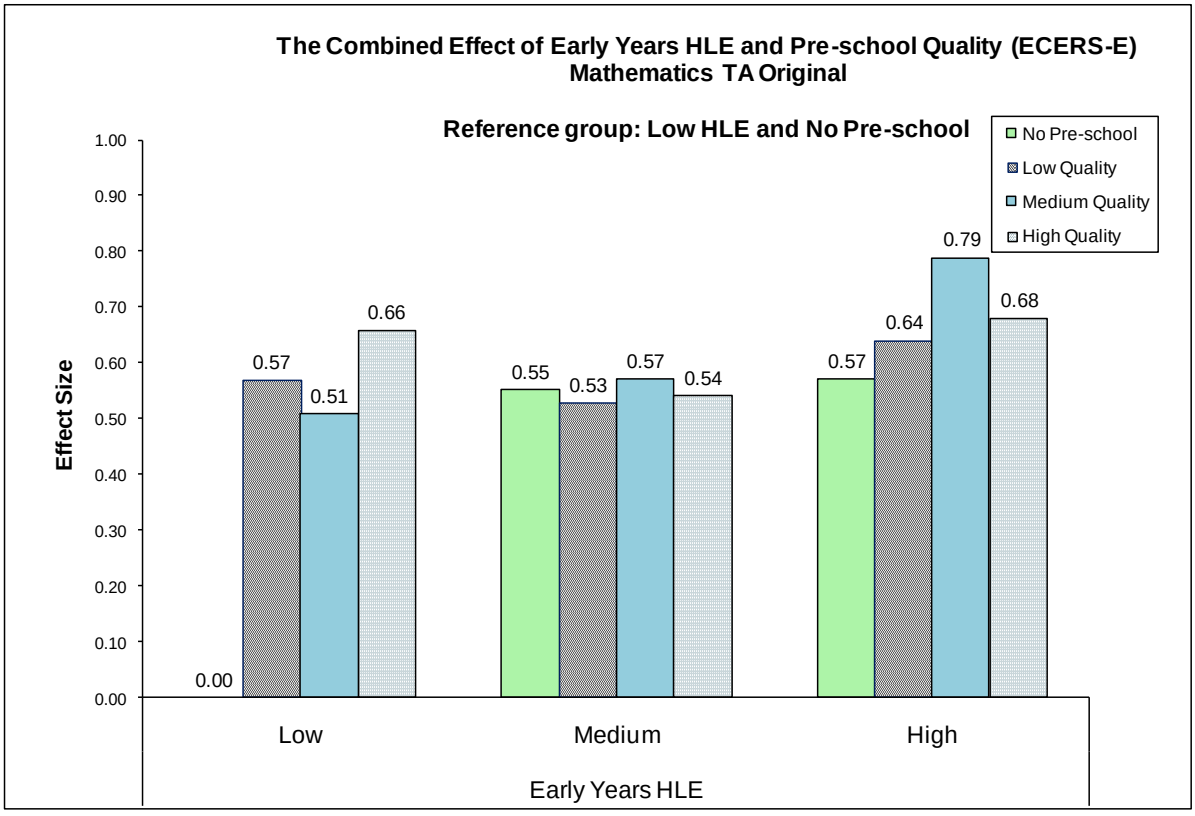
The results for the joint terms indicated that the benefits of pre-school-experience were mediated by the quality of Early Years HLE experienced by pupils.

Table 3.12: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Quality (ECERS-E) Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2493**				**3000**			
Number of schools	**579**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Quality (compared to No Pre-school and Low HLE) Low quality, Low HLE	0.66	0.18	0.57	*	0.51	0.17	0.43	*
Medium quality, Low HLE	0.59	0.15	0.51	*	0.50	0.14	0.43	*
High quality, Low HLE	0.76	0.16	0.66	*	0.66	0.16	0.56	*
No pre-school, Medium HLE	0.64	0.20	0.55	*	0.47	0.21	0.40	*
Low quality, Medium HLE	0.61	0.19	0.53	*	0.49	0.18	0.42	*
Medium quality, Medium HLE	0.66	0.15	0.57	*	0.56	0.16	0.48	*
High quality, Medium HLE	0.63	0.17	0.54	*	0.49	0.17	0.42	*
No pre-school, High HLE	0.66	0.20	0.57	*	0.58	0.20	0.50	*
Low quality, High HLE	0.74	0.17	0.64	*	0.63	0.16	0.54	*
Medium quality, High HLE	0.91	0.15	0.79	*	0.80	0.15	0.68	*
High quality, High HLE	0.79	0.16	0.68	*	0.73	0.16	0.62	*
% Reduction school variance	74%				76%			
% Reduction pupil variance	15%				12%			
% Reduction total variance	26%				25%			

* p <0.05

Figure 3.6: The Combined Impact of Early Years HLE and Pre-school Quality (ECERS-E) on Mathematics Teacher Assessment Levels in Year 9



The pattern of results for science was similar to that for Mathematics (see Figure 3.7). The medium and high quality pre-school gave the biggest boost to those who had a high Early Years HLE (Medium Quality: ES_{Orig}=0.77; $ES_{Imputed}$=0.66; High Quality: ES_{Orig}=0.64; $ES_{Imputed}$=0.57). Attending a high quality pre-school lead to better results in science even for those with low (ES_{Orig}=0.55; $ES_{Imputed}$=0.46) and medium Early Years HLE (ES_{Orig}=0.60; $ES_{Imputed}$=0.48) when compared to 'no pre-school and low HLE'.

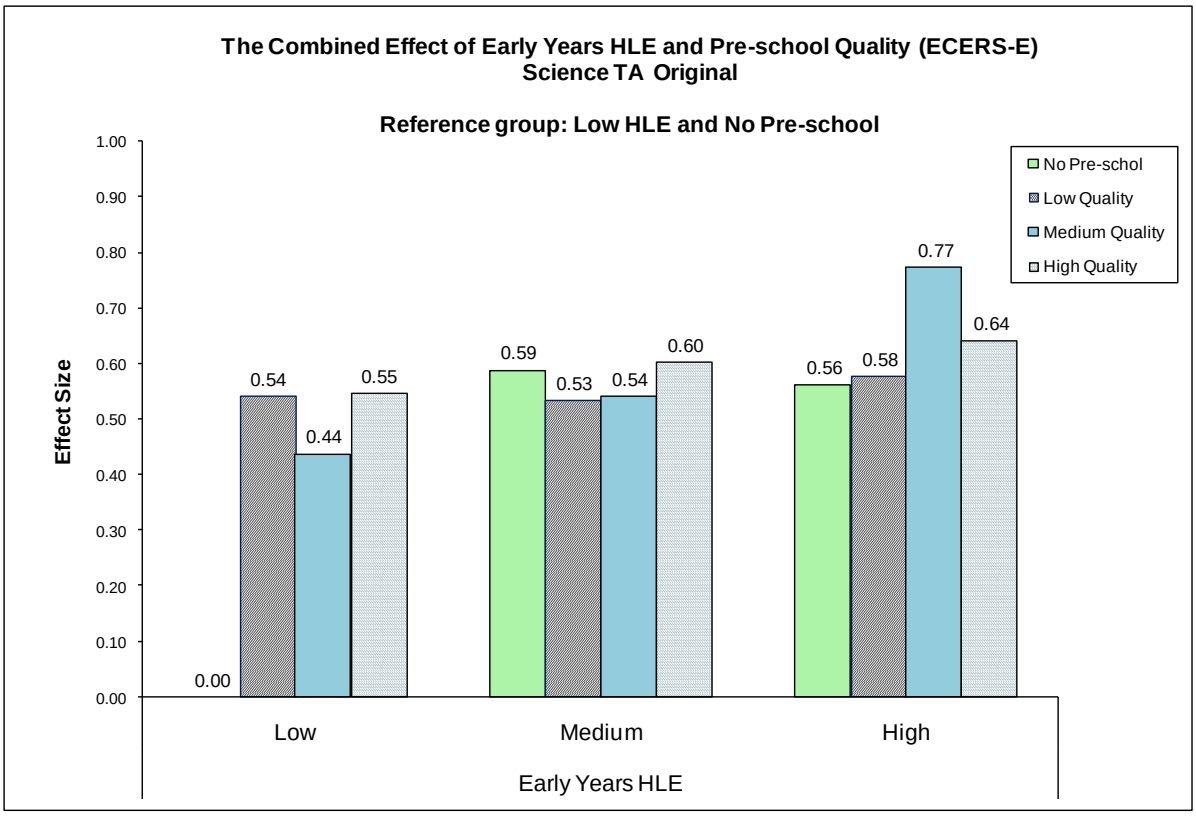
These results suggest that pre-school and the home learning environment have long lasting impact on later attainment.

Table 3.13: Contextualised Models for Science Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Quality (ECERS-E) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2480**				**3000**			
Number of schools	**578**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Quality (compared to No Pre-school and Low HLE)								
Low quality, Low HLE	0.50	0.14	0.54	*	0.40	0.14	0.42	*
Medium quality, Low HLE	0.41	0.12	0.44	*	0.35	0.12	0.37	*
High quality, Low HLE	0.51	0.13	0.55	*	0.44	0.14	0.46	*
No pre-school, Medium HLE	0.55	0.16	0.59	*	0.39	0.16	0.41	*
Low quality, Medium HLE	0.49	0.15	0.53	*	0.43	0.15	0.46	*
Medium quality, Medium HLE	0.50	0.12	0.54	*	0.42	0.13	0.44	*
High quality, Medium HLE	0.56	0.14	0.60	*	0.45	0.15	0.48	*
No pre-school, High HLE	0.52	0.16	0.56	*	0.43	0.16	0.45	*
Low quality, High HLE	0.53	0.14	0.58	*	0.45	0.14	0.47	*
Medium quality, High HLE	0.72	0.12	0.77	*	0.62	0.12	0.66	*
High quality, High HLE	0.59	0.13	0.64	*	0.54	0.13	0.57	*
% Reduction school variance	79%				76%			
% Reduction pupil variance	13%				10%			
% Reduction total variance	29%				25%			

* p <0.05

Figure 3.7: The Combined Impact of Early Years HLE and Pre-school Quality (ECERS-E) on Science Teacher Assessment Levels in Year 9



Early Years HLE and Pre-school Effectiveness

Further analyses focused on the combined term between Early Years HLE and pre-school centre effectiveness. Based on previous results, we expected to find differentiated effects of Early Years HLE and pre-school centre effectiveness on Year 9 attainment measured by English, mathematics and science TA levels.

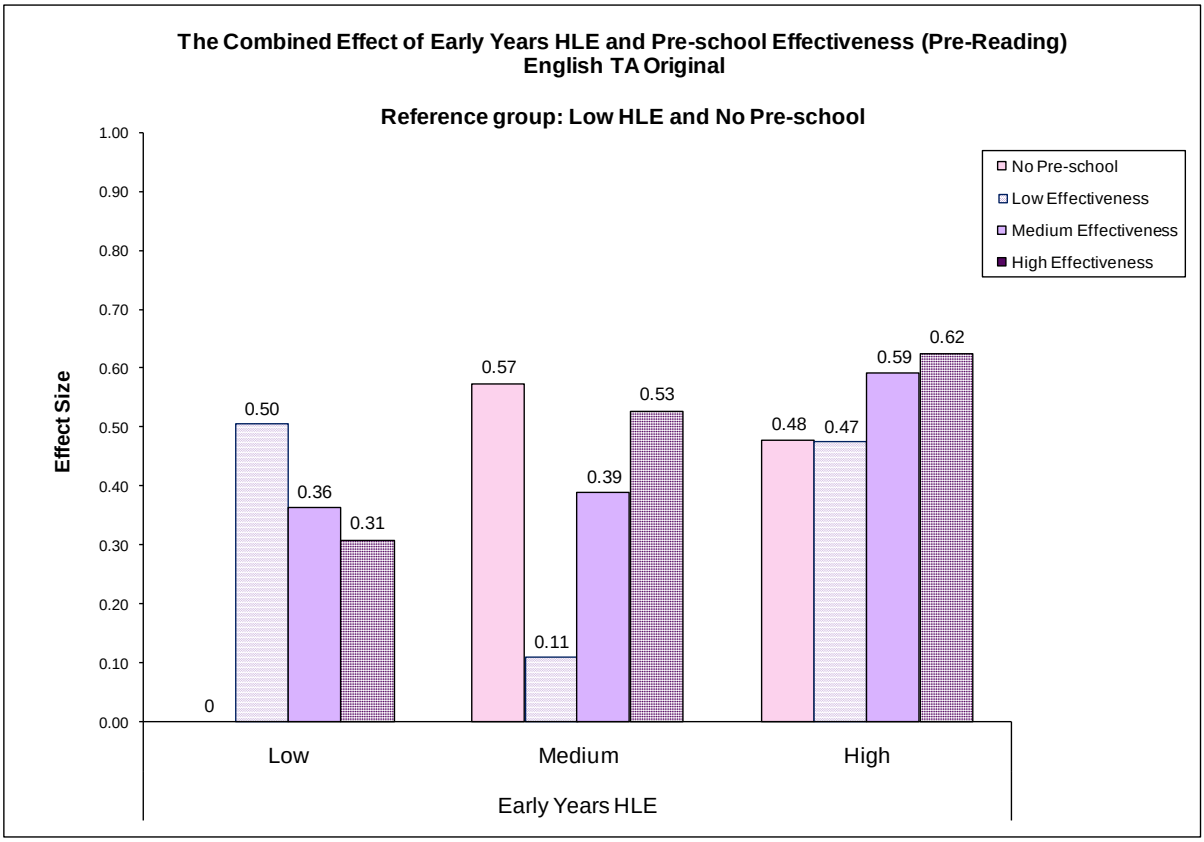
Overall, the results show that compared with the “low HLE and no pre-school group” those who had attended pre-school had better outcomes. However, the results did not indicate better outcomes in KS3 English for those pupils who had attended more effective pre-schools.

Table 3.14: Contextualised Models for English Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Effectiveness (Pre-Reading) Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				**Year 9 English TA Imputed Data STATA ICE**			
Number of pupils	**2479**				**3000**			
Number of schools	**576**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Effectiveness (compared to No Pre-school and Low HLE)								
Low effectiveness, Low HLE	0.43	0.13	0.50	*	0.35	0.13	0.41	*
Medium effectiveness, Low HLE	0.31	0.11	0.36	*	0.22	0.11	0.25	
High effectiveness, Low HLE	0.26	0.13	0.31	*	0.24	0.13	0.28	
No pre-school, Medium HLE	0.48	0.15	0.57	*	0.29	0.15	0.34	
Low effectiveness, Medium HLE	0.09	0.13	0.11		0.08	0.14	0.09	
Medium effectiveness, Medium HLE	0.33	0.11	0.39	*	0.26	0.12	0.30	*
High effectiveness, Medium HLE	0.45	0.13	0.53	*	0.36	0.14	0.41	*
No pre-school, High HLE	0.40	0.15	0.48	*	0.36	0.15	0.42	*
Low effectiveness, High HLE	0.40	0.12	0.47	*	0.37	0.13	0.43	*
Medium effectiveness, High HLE	0.50	0.11	0.59	*	0.42	0.11	0.49	*
High effectiveness, High HLE	0.53	0.12	0.62	*	0.46	0.12	0.53	*
% Reduction school variance	70%				67%			
% Reduction pupil variance	20%				16%			
% Reduction total variance	32%				29%			

* p <0.05

Figure 3.8: The Combined Impact of Early Years HLE and Pre-school Effectiveness (Pre-reading) on English Teacher Assessment Levels in Year 9



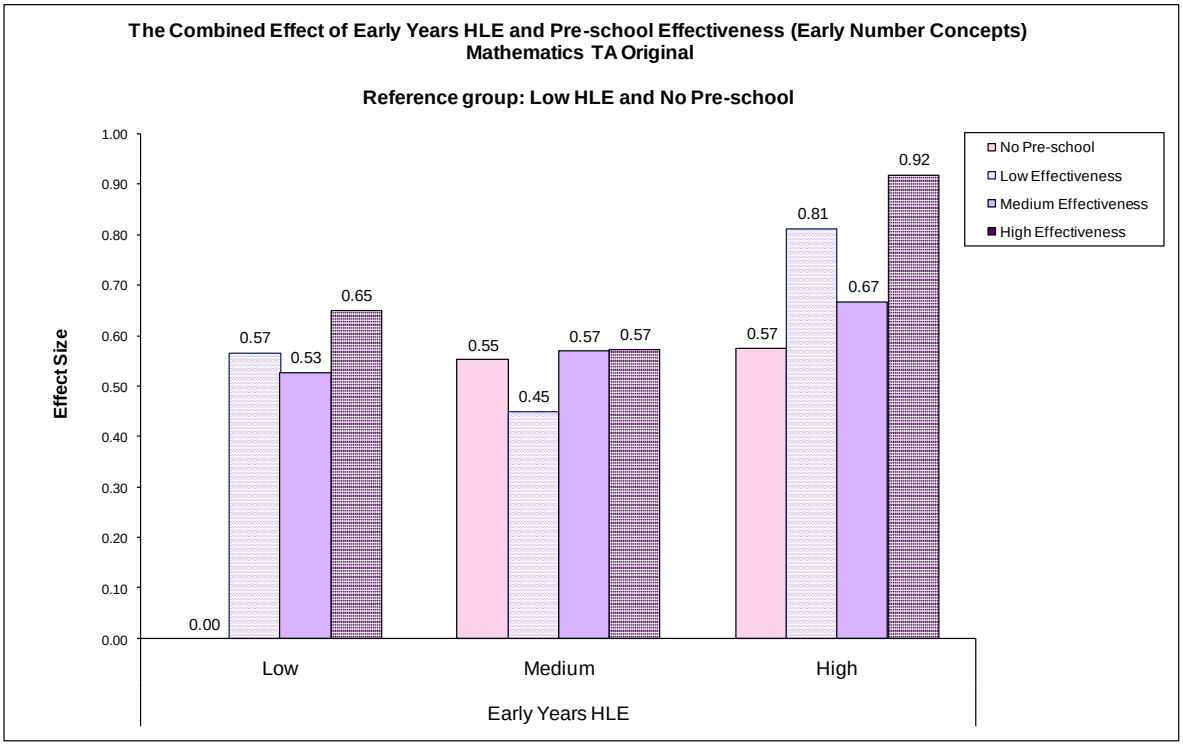
For Mathematics, high pre-school effectiveness combined with high Early Years HLE had a large effect size (ES_{Orig}=0.92; $ES_{Imputed}$=0.79), when compared to the pupils from the 'no pre-school and low HLE' group (see Figure 3.9). Pupils who had a low Early Years HLE showed more advantage if they had previously attended pre-schools that were highly effective in promoting pupils' progress in early number concepts (ES_{Orig}=0.65; $ES_{Imputed}$=0.55), as opposed to medium (ES_{Orig}=0.53; $ES_{Imputed}$=0.43) or low effective pre-schools (ES_{Orig}=0.57; $ES_{Imputed}$=0.49).

Table 3.15: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Effectiveness (Early Number Concepts) Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2493**				**3000**			
Number of schools	**579**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Effectiveness (compared to No Pre-school and Low HLE)								
Low effectiveness, Low HLE	0.66	0.18	0.57	*	0.58	0.19	0.49	*
Medium effectiveness, Low HLE	0.61	0.15	0.53	*	0.51	0.14	0.43	*
High effectiveness, Low HLE	0.75	0.17	0.65	*	0.64	0.17	0.55	*
No pre-school, Medium HLE	0.64	0.20	0.55	*	0.47	0.21	0.40	*
Low effectiveness, Medium HLE	0.52	0.20	0.45	*	0.41	0.20	0.35	*
Medium effectiveness, Medium HLE	0.66	0.15	0.57	*	0.55	0.15	0.47	*
High effectiveness, Medium HLE	0.66	0.18	0.57	*	0.54	0.18	0.46	*
No pre-school, High HLE	0.67	0.20	0.57	*	0.59	0.20	0.50	*
Low effectiveness, High HLE	0.94	0.17	0.81	*	0.84	0.17	0.72	*
Medium effectiveness, High HLE	0.77	0.15	0.67	*	0.69	0.15	0.59	*
High effectiveness, High HLE	1.07	0.17	0.92	*	0.92	0.16	0.79	*
% Reduction school variance	76%				77%			
% Reduction pupil variance	15%				12%			
% Reduction total variance	27%				26%			

* p <0.05

Figure 3.9: The Combined Impact of Early Years HLE and Pre-school Effectiveness (Early Number Concepts) on Mathematics Teacher Assessment Levels in Year 9



Strong joint effects of Early Years HLE combined with pre-school effectiveness were also obtained for Science. In the low Early Years HLE group, the ES increased with pre-school effectiveness (see Figure 3.10), in contrast to the patterns found for English. The highest effect size in this group was obtained by the pupils who had attended a highly effective pre-school when compared to those who had not attended any pre-school and had low Early Years HLE (ES_{Orig}=0.61;

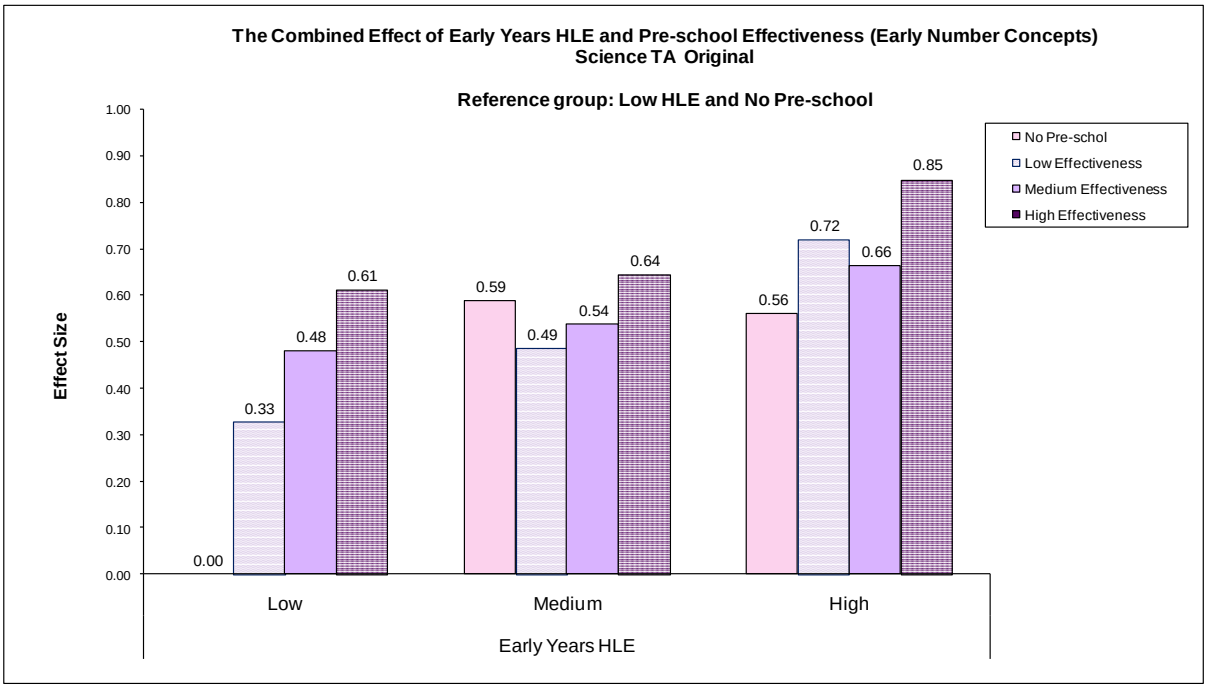
$ES_{Imputed}$=0.50). Similar gradation in attainment was found for pupils with medium Early Years HLE. However, it has to be noted that only the pupils who had attended highly effective pre-schools performed better than the pupils who had not attended a pre-school with medium level of Early Years HLE. The most advantaged pupils were again those who had attended a highly effective pre-school and had a high Early Years HLE (ES_{Orig}=0.85; $ES_{Imputed}$=0.70).

Table 3.16: Contextualised Models for Science Teacher Assessment Levels in Year 9: Early Years HLE by Pre-school Effectiveness (Early Number Concepts) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2480**				**3000**			
Number of schools	**578**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Early Years HLE by Pre-school Effectiveness (compared to No Pre-school and Low HLE)								
Low Effectiveness, Low HLE	0.30	0.15	0.33	*	0.22	0.15	0.23	
Medium Effectiveness, Low HLE	0.45	0.12	0.48	*	0.39	0.12	0.41	*
High Effectiveness, Low HLE	0.57	0.14	0.61	*	0.47	0.15	0.50	*
No pre-school, Medium HLE	0.55	0.16	0.59	*	0.39	0.16	0.41	*
Low Effectiveness, Medium HLE	0.45	0.16	0.49	*	0.35	0.17	0.36	*
Medium Effectiveness, Medium HLE	0.50	0.12	0.54	*	0.43	0.13	0.46	*
High Effectiveness, Medium HLE	0.60	0.14	0.64	*	0.47	0.14	0.50	*
No pre-school, High HLE	0.52	0.16	0.56	*	0.43	0.16	0.45	*
Low Effectiveness, High HLE	0.67	0.14	0.72	*	0.57	0.13	0.60	*
Medium Effectiveness, High HLE	0.62	0.12	0.66	*	0.55	0.12	0.58	*
High Effectiveness, High HLE	0.79	0.13	0.85	*	0.66	0.14	0.70	*
% Reduction school variance	81%				77%			
% Reduction pupil variance	13%				10%			
% Reduction total variance	29%				25%			

* *p* <0.05

Figure 3.10: The Combined Impact of Early Years HLE and Pre-school Effectiveness (Early Number Concepts) on Science Teacher Assessment Levels in Year 9



Parents' Qualification Level and the Impact of Pre-school Experience

Using the highest qualification of the parents, we divided the sample into two groups: lower versus more qualified parents. The parents who had 'no qualification', 'vocational' or '16 academic' were categorised as lower qualified. Thus, if both of the parents were in any of these 3 groups the *Parent's highest qualification* variable was set to lower qualified. Conversely, if at least one of the parents had a qualification higher than '16 academic' then the *Parent's highest qualification* variable was set as moderate/high. Joint measures were created between parents' highest qualification and pre-school attendance, pre-school quality and pre-school effectiveness. The combined terms were then entered into the contextualised models predicting cognitive attainment (English, mathematics and science TA levels) in Year 9 and controlling for individual and family characteristics.

With regard to the effect of past pre-school attendance, pre-school continues to be a statistically significant predictor for later attainment in Year 9. This is the case for the attainment in English but only for pupils of highly qualified parents (ES_{Orig}=0.55; $ES_{Imputed}$=0.43). However, for mathematics and science TA levels, pre-school attendance had a statistically significant effect for pupils of both low and highly qualified parents (see Table 3.18 and Table 3.19).

Table 3.17: Contextualised Models for English Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Attendance Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2519**				**3000**			
Number of schools	**580**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Attendance (compared to No Pre-school and Low Qualification)								
No pre-school, Moderate/High Qualification	0.20	0.17	0.24		0.21	0.17	0.24	
Pre-school, Lower Qualification	0.13	0.08	0.15		0.12	0.08	0.14	
Pre-school, Moderate/High Qualification	0.47	0.09	0.55	*	0.38	0.10	0.43	*
% Reduction school variance	67%				68%			
% Reduction pupil variance	18%				15%			
% Reduction total variance	30%				29%			

* p <0.05

Figure 3.11: The Combined Impact of Parents' Highest Qualification and Pre-school Attendance on English Teacher Assessment Levels in Year 9

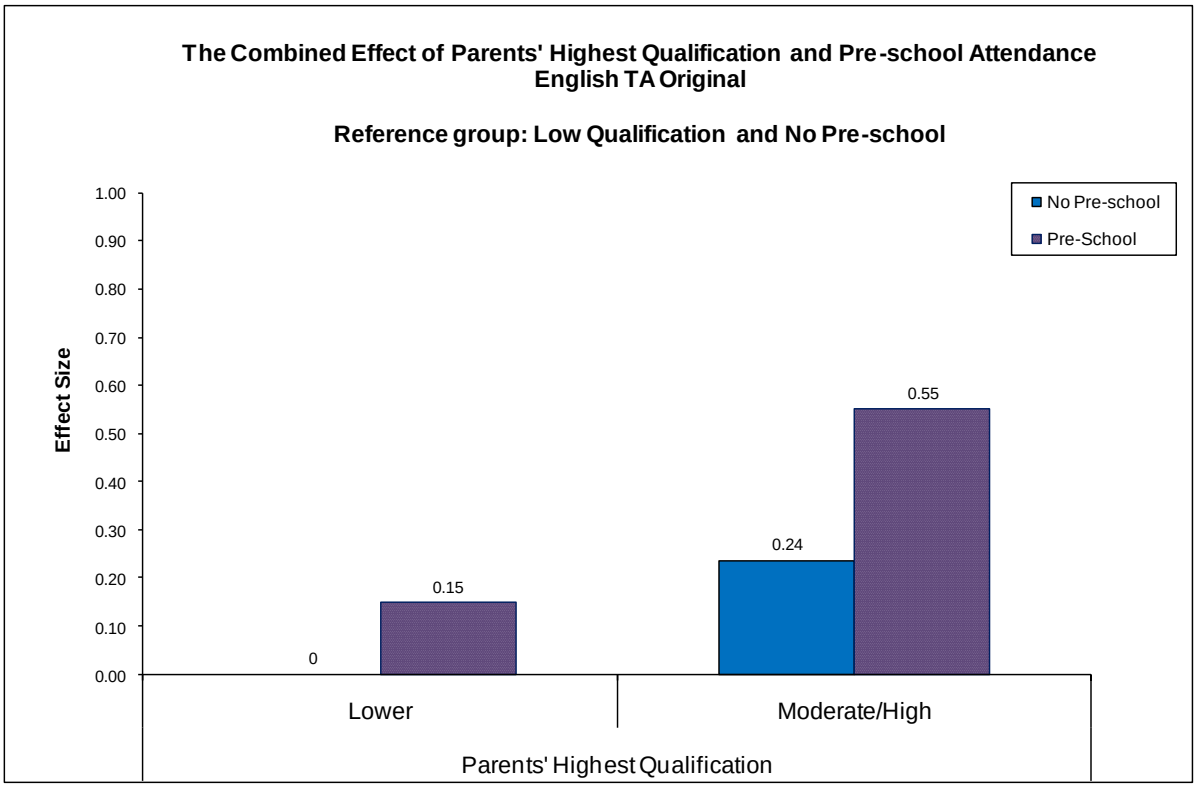


Table 3.18: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Attendance Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2529**				**3000**			
Number of schools	**583**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Attendance (compared to No Pre-school and Low Qualification)								
No pre-school, Moderate/High Qualification	0.19	0.23	0.16		0.09	0.27	0.08	
Pre-school, Low Qualification	0.32	0.10	0.28	*	0.27	0.11	0.23	*
Pre-school, Moderate/High Qualification	0.76	0.12	0.66	*	0.63	0.12	0.53	*
% Reduction school variance	76%				76%			
% Reduction pupil variance	14%				11%			
% Reduction total variance	26%				25%			

* p <0.05

Figure 3.12: The Combined Impact of Parents' Highest Qualification and Pre-school Attendance on Mathematics Teacher Assessment Levels in Year 9

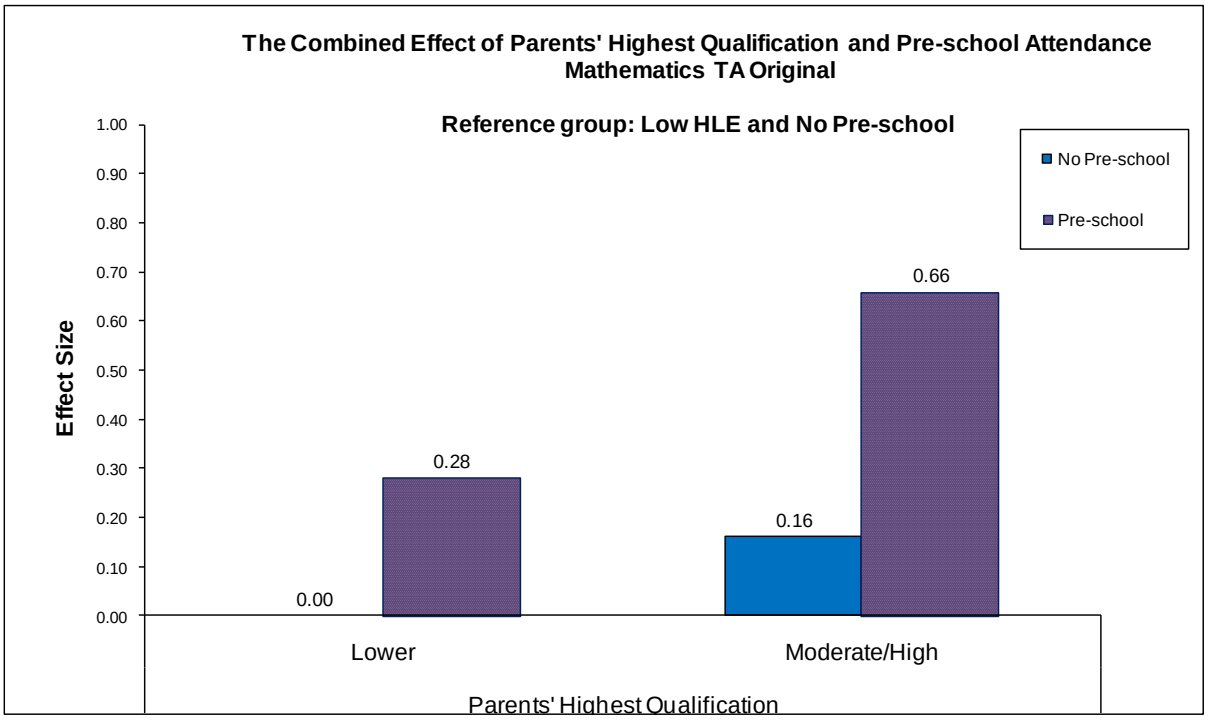
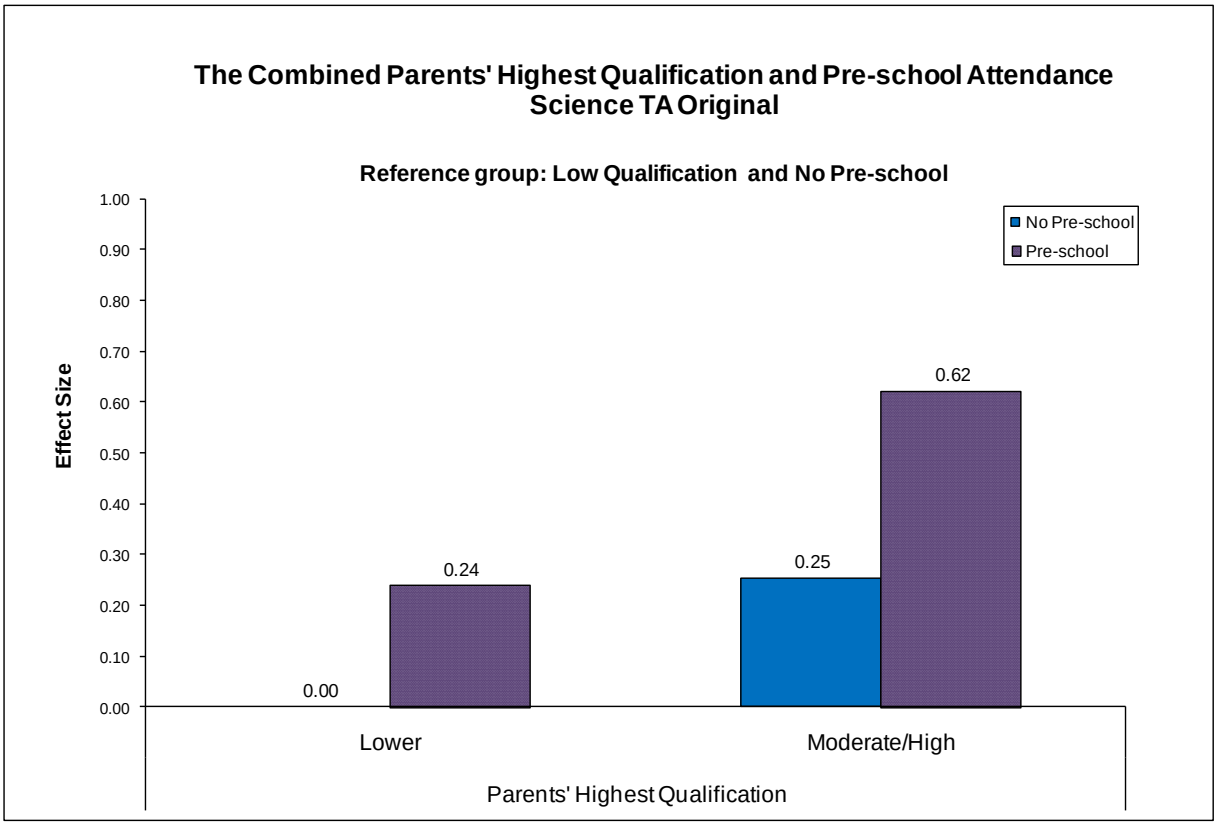


Table 3.19: Contextualised Models for Science Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Attendance Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2520**				**3000**			
Number of schools	**582**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Attendance (compared to No Pre-school and Low Qualification)								
No pre-school, Moderate/High Qualification	0.24	0.19	0.25		0.15	0.21	0.15	
Pre-school, Low Qualification	0.22	0.08	0.24	*	0.23	0.08	0.24	*
Pre-school, Moderate/High Qualification	0.58	0.09	0.62	*	0.51	0.09	0.53	*
% Reduction school variance	79%				77%			
% Reduction pupil variance	11%				08%			
% Reduction total variance	27%				24%			

* p <0.05

Figure 3.13: The Combined Impact of Parents' Highest Qualification and Pre-school Attendance on Science Teacher Assessment Levels in Year 9



Parents' Qualification Level and Pre-school Quality and Effectiveness

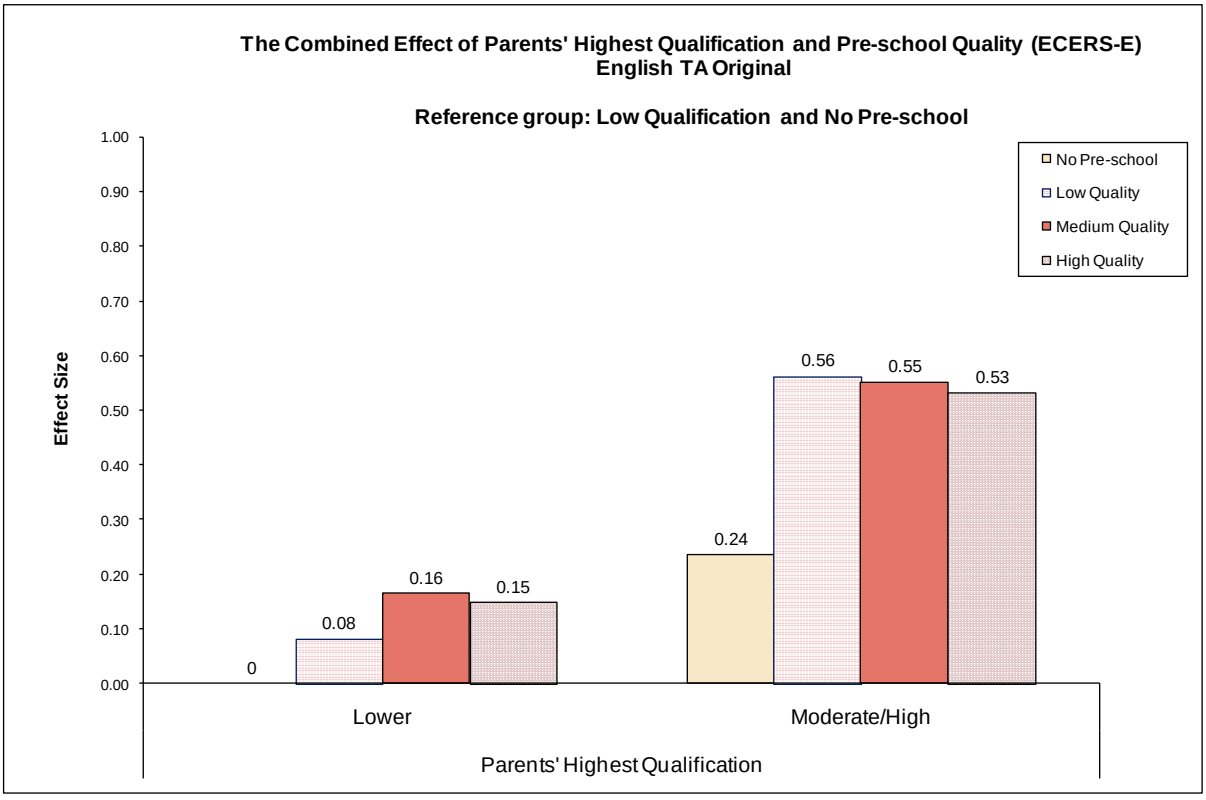
For English, both pre-school quality and pre-school effectiveness were statistically significant only for pupils of higher qualified parents (see Figure 3.14 and Figure 3.17). Within this specific group, the pre-school effects were similar regardless of the quality. These results reinforce the fact that parents' qualification remained a strong predictor of better English attainment in the long term. For English, therefore parents' qualification remains important, however it seems that there remains an extra benefit from having attended pre-school, although there is no clear trend linked to quality, in contrast to findings in primary school.

Table 3.20: Contextualised Models for English Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Quality (ECERS-E) Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	2519				3000			
Number of schools	580				800			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Quality (compared to No Pre-school and Low Qualification)								
Low quality, Low Qualification	0.07	0.10	0.08		0.03	0.10	0.03	
Medium quality, Low Qualification	0.14	0.08	0.16		0.13	0.08	0.15	
High quality, Low Qualification	0.13	0.09	0.15		0.14	0.09	0.16	
No pre-school, Moderate/High Qualification	0.20	0.17	0.24		0.21	0.17	0.24	
Low quality, Moderate/High Qualification	0.48	0.12	0.56	*	0.38	0.13	0.43	*
Medium quality, Moderate/High Qualification	0.47	0.09	0.55	*	0.39	0.10	0.44	*
High quality, Moderate/High Qualification	0.46	0.11	0.53	*	0.36	0.11	0.41	*
% Reduction school variance	68%				69%			
% Reduction pupil variance	18%				15%			
% Reduction total variance	30%				29%			

* p <0.05

Figure 3.14: The Combined Impact of Parents' Highest Qualification and Pre-school Quality (ECERS-E) on English Teacher Assessment Levels in Year 9



In contrast to results for English, the results for mathematics and science indicated that attainment in these subjects were sensitive to pre-school quality (see Figure 3.15). Medium and high quality pre-school benefited pupils of parents with lower qualification (Medium quality: ES_{Orig}=0.29; $ES_{Imputed}$=0.25; High quality: ES_{Orig}=0.30; $ES_{Imputed}$=0.26). On the other hand, pupils of higher qualified parents, regardless of the attended pre-school's quality, had significantly greater attainment in mathematics than the 'home' pupils with lower qualified parents. However, pupils of

higher qualified parents who had not attended pre-school showed lower outcomes than those who had attended pre-school.

The pattern was similar for science (see Table 3.22 and Figure 3.16). Pupils of higher qualified parents who had attended low quality pre-school differed substantially (ES_{Orig}=0.60; $ES_{Imputed}$=0.53) from those who had not attended pre-school and were of lower qualified parents. This was also the case for those who had attended medium quality pre-schools: pupils with low qualified parents had lower attainment (ES_{Orig}=0.23; $ES_{Imputed}$=0.23) than those of highly qualified parents (ES_{Orig}=0.66; $ES_{Imputed}$=0.56).

In summary, pupils of lower qualified parents seem to be more sensitive to benefits of the quality of the pre-school attended, the higher the quality the better their cognitive outcome in Year 9, in mathematics and science, although the differences are small. For the pupils of moderately to highly qualified parents there was no clear pattern of the effects related to pre-school quality.

Table 3.21: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Quality (ECERS-E) Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2529**				**3000**			
Number of schools	**583**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Quality (compared to No Pre-school and Lower Qualification)								
Low quality, Lower Qualification	0.22	0.13	0.19		0.14	0.13	0.12	
Medium quality, Lower Qualification	0.34	0.11	0.29	*	0.30	0.11	0.25	*
High quality, Lower Qualification	0.35	0.12	0.30	*	0.31	0.12	0.26	*
No pre-school, Moderate/High Qualification	0.19	0.23	0.16		0.09	0.27	0.08	
Low quality, Moderate/High Qualification	0.83	0.16	0.72	*	0.64	0.15	0.55	*
Medium quality, Moderate/High Qualification	0.77	0.12	0.66	*	0.64	0.12	0.54	*
High quality, Moderate/High Qualification	0.71	0.14	0.61	*	0.58	0.14	0.50	*
% Reduction school variance	76%				76%			
% Reduction pupil variance	14%				11%			
% Reduction total variance	26%				25%			

* p <0.05

Figure 3.15: The Combined Impact of Parents' Highest Qualification and Pre-school Quality (ECERS-E) on Mathematics Teacher Assessment Levels in Year 9

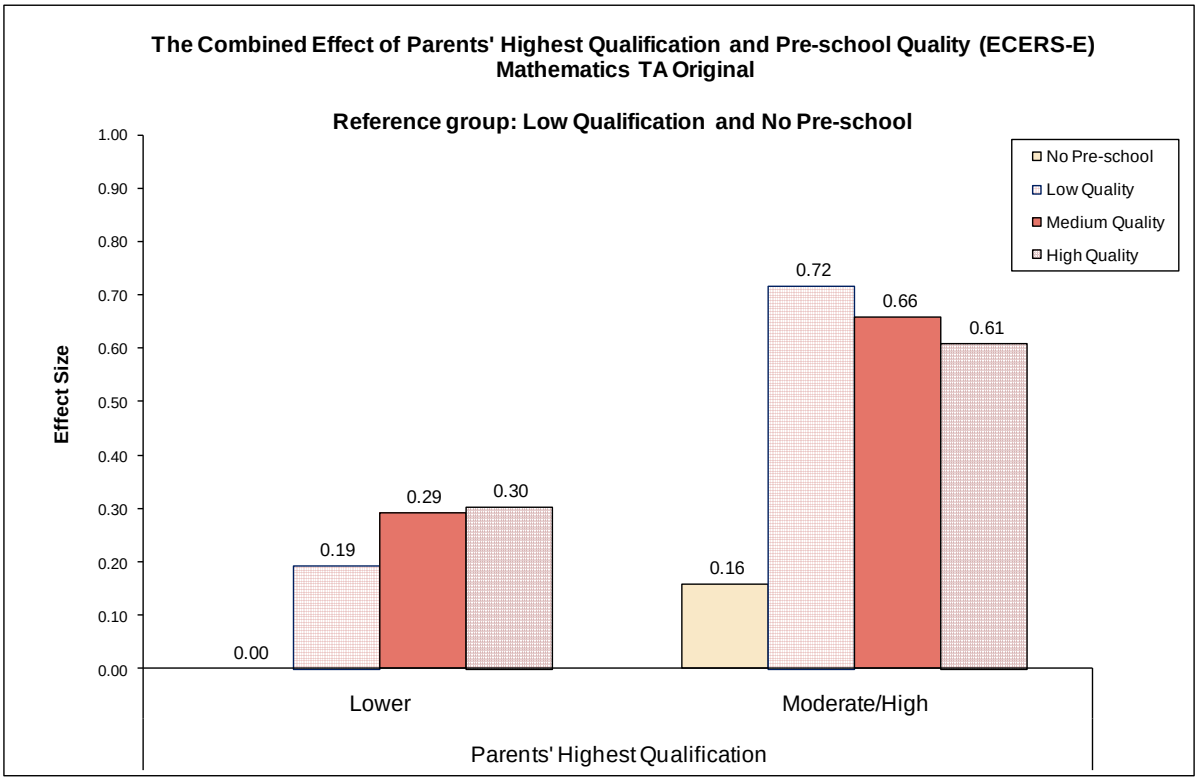
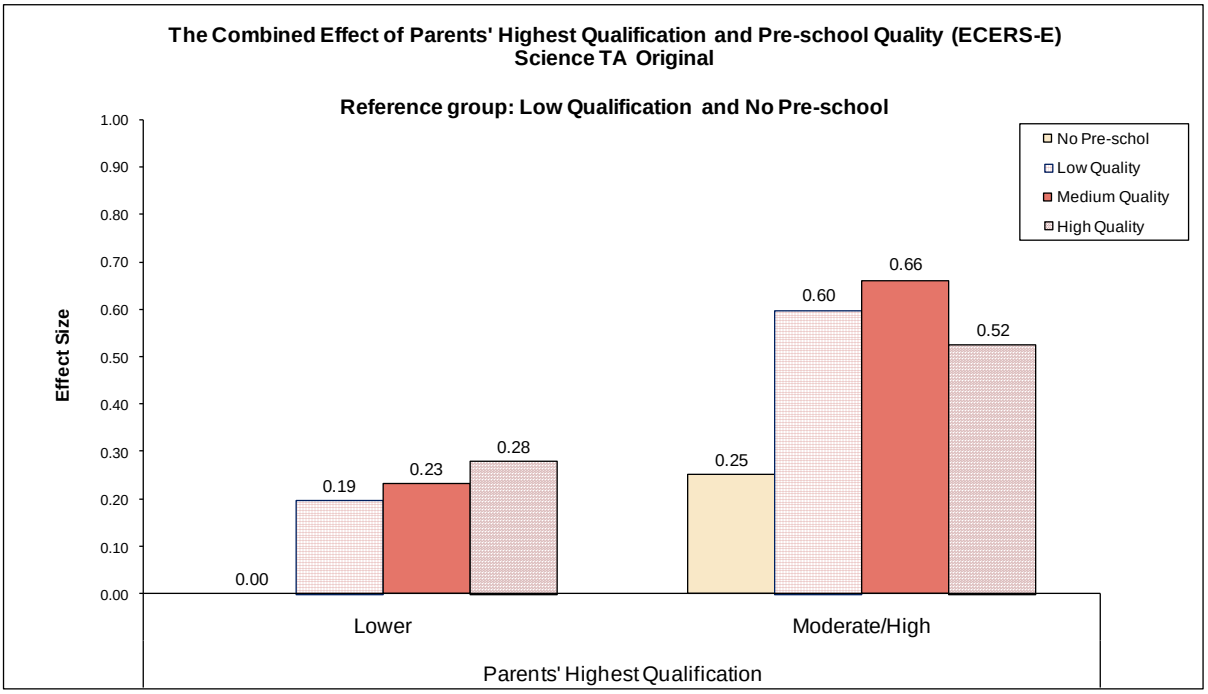


Table 3.22: Contextualised Models for Science Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Quality (ECERS-E) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2520**				**3000**			
Number of schools	**582**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Quality (compared to No Pre-school and Lower Qualification)								
Low quality, Lower Qualification	0.18	0.10	0.19		0.14	0.11	0.15	
Medium quality, Lower Qualification	0.22	0.09	0.23	*	0.22	0.09	0.23	*
High quality, Lower Qualification	0.26	0.10	0.28	*	0.28	0.10	0.29	*
No pre-school, Moderate/High Qualification	0.24	0.19	0.25		0.14	0.21	0.15	
Low quality, Moderate/High Qualification	0.56	0.13	0.60	*	0.51	0.13	0.53	*
Medium quality, Moderate/High Qualification	0.62	0.10	0.66	*	0.54	0.10	0.56	*
High quality, Moderate/High Qualification	0.49	0.12	0.52	*	0.42	0.11	0.44	*
% Reduction school variance	80%				78%			
% Reduction pupil variance	11%				08%			
% Reduction total variance	27%				24%			

* p <0.05

Figure 3.16: The Combined Impact of Parents' Highest Qualification and Pre-school Quality (ECERS-E) on Science Teacher Assessment Levels in Year 9



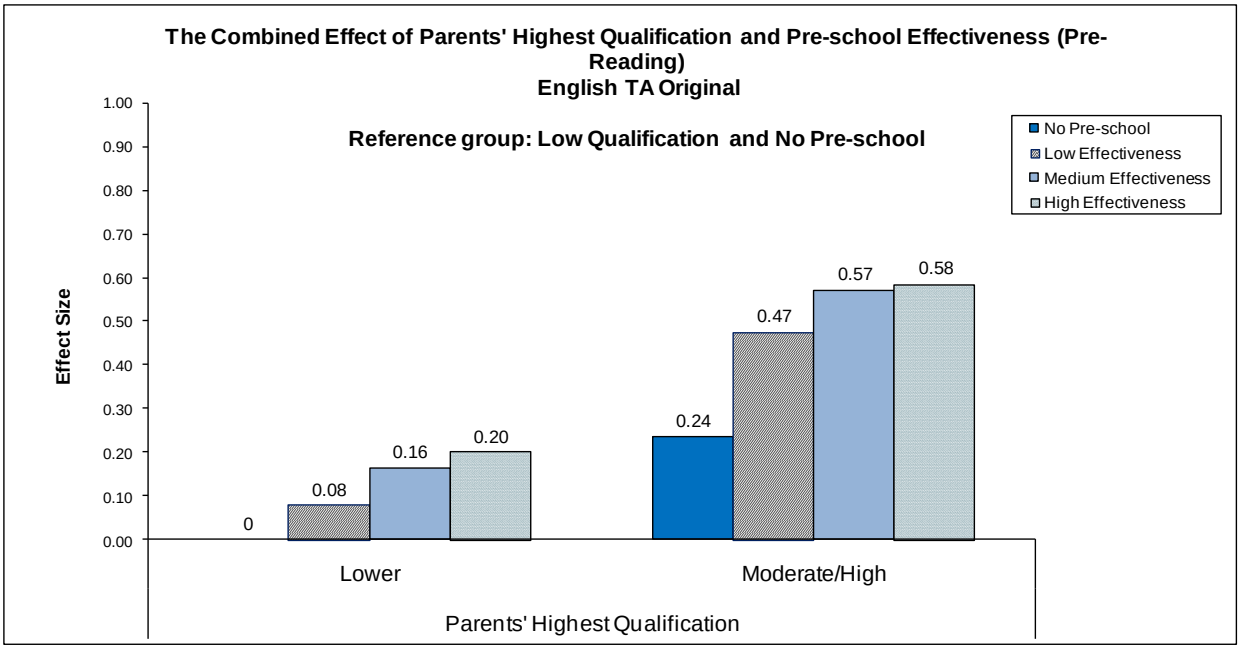
The combined effect of parents' qualifications and pre-school effectiveness displayed similar patterns as the combined effect of parents' qualifications and pre-school quality. For English, pre-school effectiveness influenced outcomes only for the pupils of higher qualified parents. Thus, pupils from this group, regardless of pre-school effectiveness, had significantly greater attainment than pupils from the lower qualified/no pre-school group (see Figure 3.17). Differences in attainment based on pre-school effectiveness for pupils of lower qualified parents were not statistically significant from those who had not attended a pre-school, although the effect sizes were in the direction predicted.

Table 3.23: Contextualised Models for English Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Effectiveness (Pre-Reading) Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2519**				**3000**			
Number of schools	**580**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Effectiveness (compared to No Pre-school and Lower Qualification)								
Low effectiveness, Lower Qualification	0.07	0.09	0.08		0.06	0.09	0.07	
Medium effectiveness, Lower Qualification	0.14	0.08	0.16		0.12	0.08	0.14	
High effectiveness, Lower Qualification	0.17	0.09	0.20		0.17	0.09	0.20	
No pre-school, Moderate/High Qualification	0.20	0.17	0.24		0.21	0.17	0.24	
Low effectiveness, Moderate/High Qualification	0.41	0.11	0.47	*	0.37	0.12	0.43	*
Medium effectiveness, Moderate/High Qualification	0.49	0.09	0.57	*	0.37	0.10	0.43	*
High effectiveness, Moderate/High Qualification	0.50	0.11	0.58	*	0.41	0.11	0.47	*
% Reduction school variance	68%				69%			
% Reduction pupil variance	18%				15%			
% Reduction total variance	30%				29%			

* p <0.05

Figure 3.17: The Combined Impact of Parents' Highest Qualification and Pre-school Effectiveness (Pre-reading) on English Teacher Assessment Levels in Year 9



Pre-school effectiveness was found to be more influential for Year 9 mathematics and science. Thus, the differences based on the pre-school effectiveness were statistically significant for both the 'lower' and 'higher qualified parents' categories when compared to pupils who had not attended a pre-school. As with pre-school quality, for pupils of higher qualified parents, pre-school effectiveness predicted Year 9 outcomes in the direction expected, and with greater attainment than 'home' pupils with lower qualified parents.

Compared to 'home' pupils with lower qualified parents, pupils with lower qualified parents who had attended low effective pre-schools had lower attainment in mathematics (ES_{Orig}=0.31; $ES_{Imputed}$=0.25) and science (although not significant, ES_{Orig}=0.17^{ns}; $ES_{Imputed}$=0.17^{ns}) than pupils with higher qualified parents who had attended low effective pre-schools (mathematics: ES_{Orig}=0.65; $ES_{Imputed}$=0.56; science: ES_{Orig}=0.56; $ES_{Imputed}$=0.46). Similar differences in attainment were found for those who attended a pre-school with medium level of effectiveness: pupils with lower qualified parents had lower attainment (mathematics: ES_{Orig}=0.24; $ES_{Imputed}$=0.19; science: ES_{Orig}=0.20; $ES_{Imputed}$=0.20) than those with higher qualified parents (mathematics: ES_{Orig}=0.64; $ES_{Imputed}$=0.52; science: ES_{Orig}=0.64; $ES_{Imputed}$=0.56). Finally, the same pattern of differences was found for pupils with lower qualified parents who attended high effective pre-schools (mathematics: ES_{Orig}=0.38; $ES_{Imputed}$=0.34; science: ES_{Orig}=0.40; $ES_{Imputed}$=0.38) and pupils with higher qualified parents who attended high effectiveness pre-schools (mathematics: ES_{Orig}=0.71; $ES_{Imputed}$=0.57; science: ES_{Orig}=0.60; $ES_{Imputed}$=0.49).

For Year 9 attainment in mathematics and science, pupils of lower qualified parents benefited more from highly and medium effective pre-school, but not particularly from low effective pre-schools. This suggests that pre-school effects still shape pupils' attainment in the longer term into lower secondary education.

Table 3.24: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Effectiveness (Early Number Concepts) Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2529**				**3000**			
Number of schools	**583**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Effectiveness (compared to No Pre-school and Lower Qualification)								
Low effectiveness, Lower Qualification	0.36	0.13	0.31	*	0.30	0.13	0.25	*
Medium effectiveness, Lower Qualification	0.28	0.11	0.24	*	0.23	0.11	0.19	*
High effectiveness, Lower Qualification	0.44	0.12	0.38	*	0.40	0.12	0.34	*
No pre-school, Moderate/High Qualification	0.19	0.23	0.16		0.10	0.27	0.08	
Low effectiveness, Moderate/High Qualification	0.76	0.17	0.65	*	0.66	0.16	0.56	*
Medium effectiveness, Moderate/High Qualification	0.75	0.12	0.64	*	0.61	0.12	0.52	*
High effectiveness, Moderate/High Qualification	0.83	0.15	0.71	*	0.67	0.15	0.57	*
% Reduction school variance	77%				76%			
% Reduction pupil variance	14%				11%			
% Reduction total variance	26%				25%			

* p <0.05

Figure 3.18: The Combined Impact of Parents' Highest Qualification and Pre-school Effectiveness (Early Number Concepts) on Mathematics Teacher Assessment Levels in Year 9

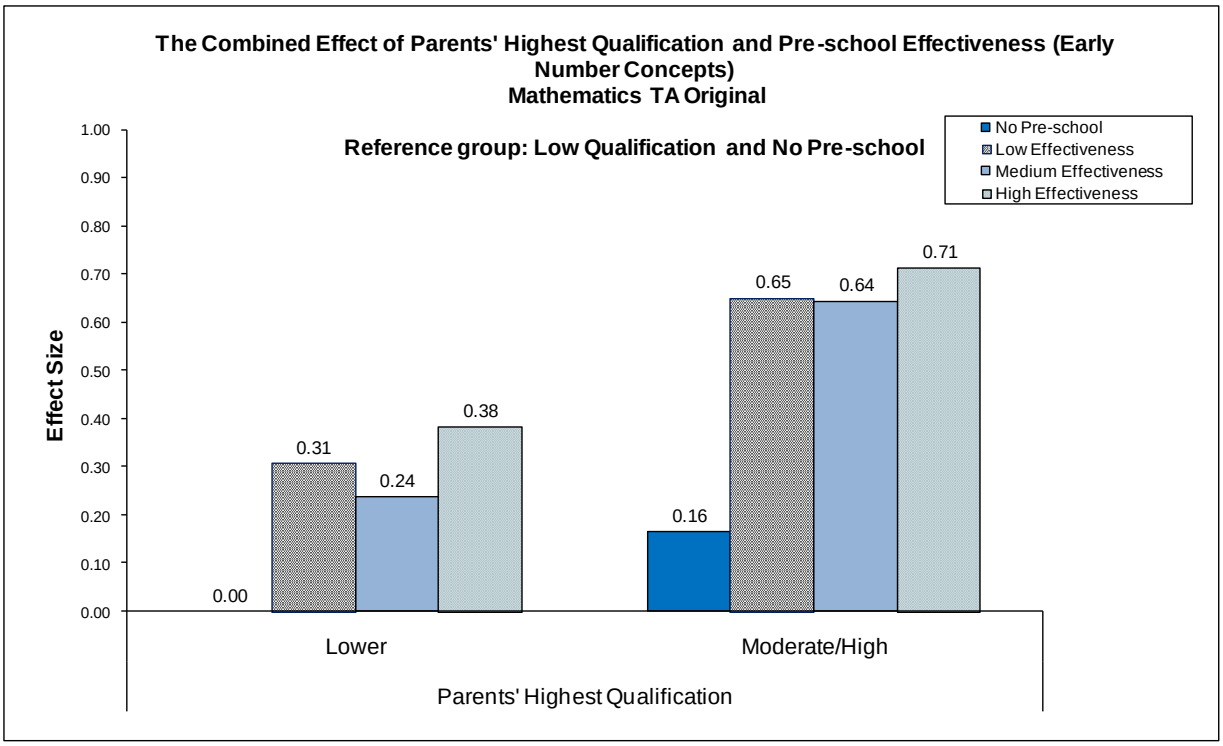
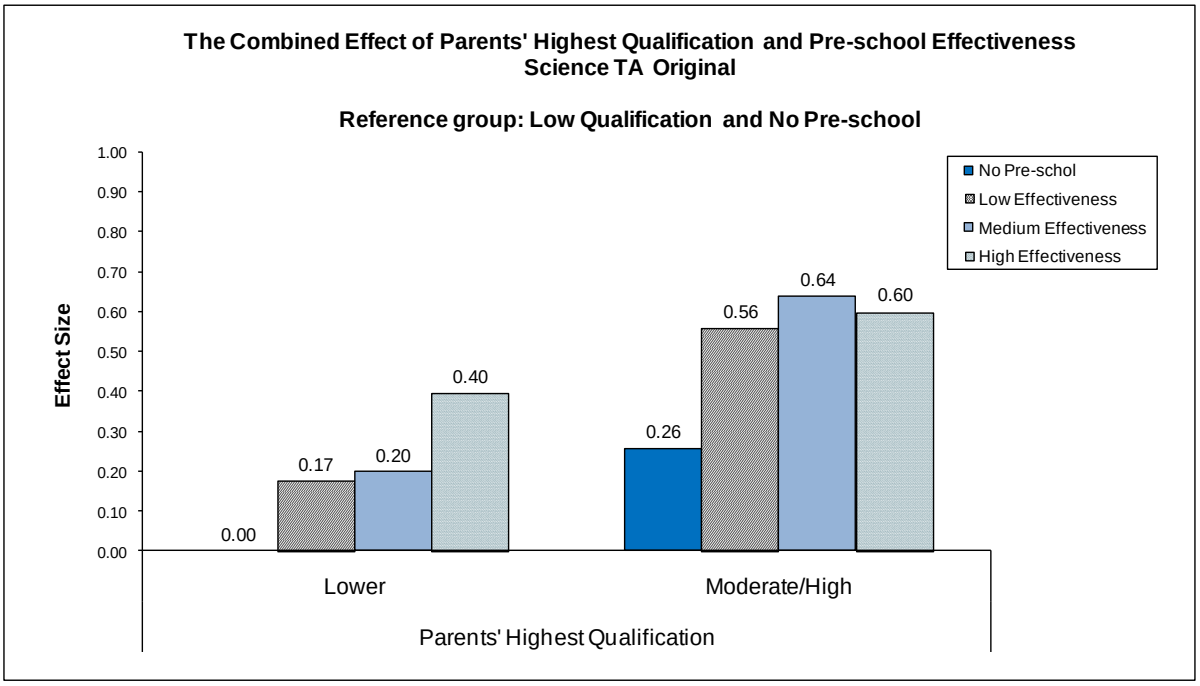


Table 3.25: Contextualised Models for Science Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Pre-school Effectiveness (Early Number Concepts) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	2520				3000			
Number of schools	582				800			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Pre-school Effectiveness (compared to No Pre-school and Lower Qualification)								
Low effectiveness, Lower Qualification	0.16	0.11	0.17		0.16	0.11	0.17	
Medium effectiveness, Lower Qualification	0.19	0.09	0.20	*	0.19	0.09	0.20	*
High effectiveness, Lower Qualification	0.37	0.10	0.40	*	0.37	0.10	0.38	*
No pre-school, Moderate/High Qualification	0.24	0.19	0.26		0.15	0.20	0.15	
Low effectiveness, Moderate/High Qualification	0.52	0.13	0.56	*	0.44	0.13	0.46	*
Medium effectiveness, Moderate/High Qualification	0.60	0.10	0.64	*	0.53	0.10	0.56	*
High effectiveness, Moderate/High Qualification	0.56	0.12	0.60	*	0.47	0.12	0.49	*
% Reduction school variance	80%				77%			
% Reduction pupil variance	11%				08%			
% Reduction total variance	27%				25%			

* p <0.05

Figure 3.19: The Combined Impact of Parents' Highest Qualification and Pre-school Effectiveness (Early Number Concepts) on Science Teacher Assessment Levels inYear 9

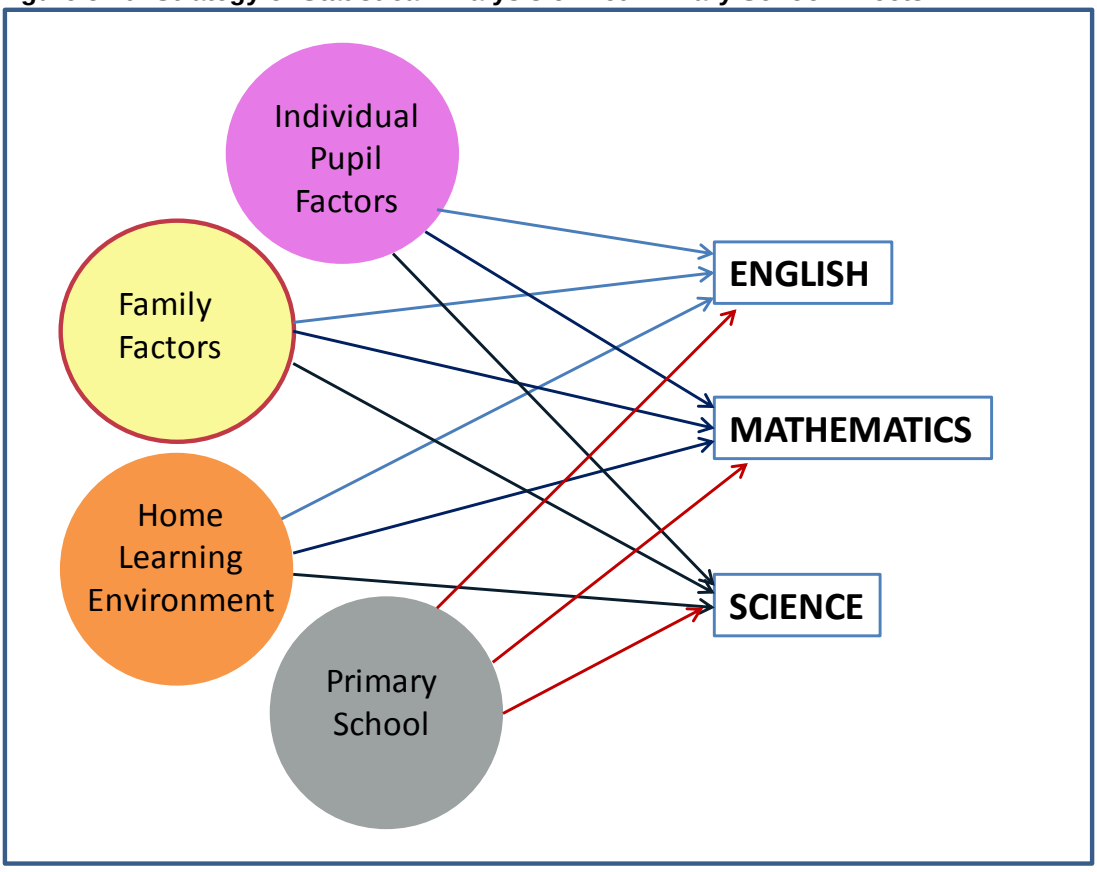


3.2. The Impact of Primary School Academic Effectiveness on Year 9 Attainment

Earlier in the study, measures of the academic effectiveness of the primary school attended had been derived. The value added effectiveness measures for primary schools were calculated using National Assessment data for all primary schools in England linking KS1 and KS2 results, and separate indicators were calculated for the different core curriculum subjects English, mathematics and science (Melhuish et al., 2006a; 2006b). These provided a measure of the academic success of individual primary school in promoting pupils' academic progress. For each EPPSE pupil, these measures provide indicators of the academic quality of their primary schools.

It was hypothesised that primary school might also continue to affect later attainment up to Year 9[23]. To test this hypothesis, effectiveness measures of primary school academic effectiveness were incorporated in multilevel models to explore the influence of the primary school attended on promoting academic attainment in Year 9. Primary school academic effectiveness in English was modelled as a potential predictor for pupils' English outcomes in Year 9, and primary school academic effectiveness in mathematics was used as a potential predictor for outcomes in mathematics and science, while the primary school academic effectiveness in science was also tested as a predictor for the Year 9 science (see Figure 3.20 for the statistical analysis strategy).

Figure 3.20: Strategy of Statistical Analysis of Net Primary School Effects

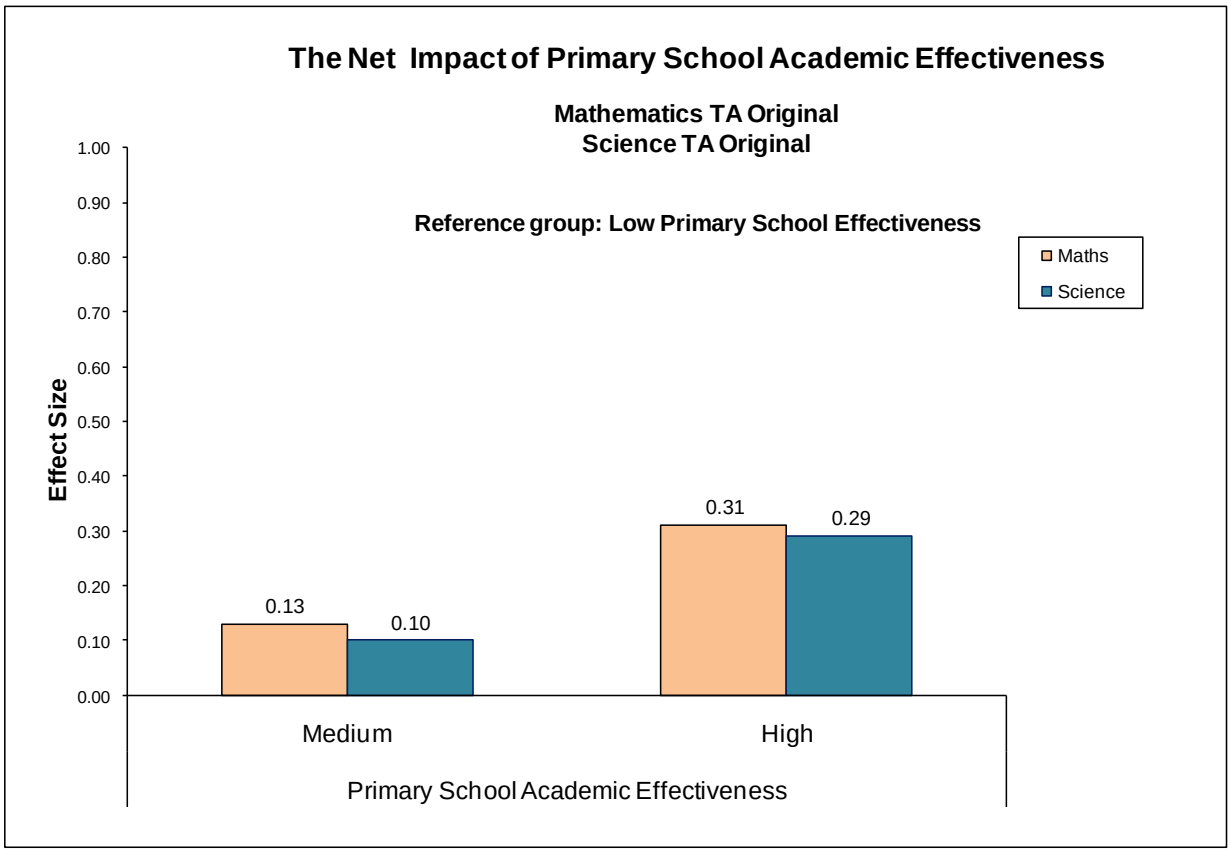


[23] It was not appropriate to use cross classified models to examine the effects of primary and secondary school simultaneously as there were too many cells in the cross classification with one individual pupil

The academic effectiveness of the primary school had been found to predict outcomes in Year 5 and Year 6 (Sammons et al., 2007a; 2008a).

The primary school academic effectiveness was not statistically significant for the Year 9 attainment in English measured by TA levels. However, the academic effectiveness of the primary school attended remained a significant predictor of pupils' attainment in Year 9 mathematics and science. The primary school makes an identifiable and separate contribution to pupils' later attainment at Year 9 in these two subjects, after controlling for individual pupil, family and HLE influences.

Figure 3.21: The Impact of Primary School Academic Effectiveness on Mathematics and Science Teacher Assessment Levels in Year 9



Pupils who had attended a highly or medium effective primary school in terms of mathematics had significantly higher mathematics TA levels (Medium: ES_{Orig}=0.13; $ES_{Imputed}$=0.11^{ns}; High: ES_{Orig}=0.31; $ES_{Imputed}$=0.28) than pupils who had attended a low effective primary school. For Science, only attending a highly effective primary school was a significant predictor of higher TA levels (ES_{Orig}=0.29; $ES_{Imputed}$=0.27). Additionally, the primary school academic effectiveness in mathematics was a better predictor for science than primary school academic effectiveness in science (see Table 3.27 and Table 3.28).

Table 3.26: Contextualised Models for English Teacher Assessment in Year 9: Primary School Academic Effectiveness (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**3000**			
Number of schools	**533**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Primary School Effectiveness (compared to low effectiveness)								
Missing	0.11	0.07	0.13		-0.03	0.06	-0.03	
Medium Effectiveness	0.09	0.05	0.10		0.04	0.06	0.05	
High Effectiveness	0.02	0.08	0.03		0.04	0.08	0.04	
% Reduction school variance	79%				70%			
% Reduction pupil variance	25%				16%			
% Reduction total variance	38%				30%			

* p <0.05

Table 3.27: Contextualised Models for Mathematics Teacher Assessment in Year 9: Primary School Academic Effectiveness (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Primary School Academic Effectiveness (compared to low effectiveness)								
Missing	0.13	0.09	0.11		0.07	0.08	0.06	
Medium Effectiveness	0.14	0.07	0.13	*	0.13	0.07	0.11	
High Effectiveness	0.36	0.11	0.31	*	0.33	0.10	0.28	*
% Reduction school variance	84%				79%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	29%				26%			

* p <0.05

Table 3.28: Contextualised Models for Science Teacher Assessment in Year 9: Primary School Academic Effectiveness (Maths) (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Primary School Academic Effectiveness (compared to low effectiveness)								
Missing	0.10	0.07	0.11		0.10	0.07	0.10	
Medium Effectiveness	0.09	0.06	0.10		0.09	0.06	0.10	
High Effectiveness	0.26	0.08	0.29	*	0.26	0.08	0.27	*
% Reduction school variance	89%				80%			
% Reduction pupil variance	17%				10%			
% Reduction total variance	34%				26%			

* p <0.05

Table 3.29: Contextualised Models for Science Teacher Assessment in Year 9: Primary School Academic Effectiveness (Science) (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Primary School Academic Effectiveness (compared to low effectiveness) Missing	0.07	0.08	0.08		-0.01	0.08	-0.01	
Medium Effectiveness	0.05	0.06	0.06		0.04	0.07	0.04	
High Effectiveness	0.22	0.08	0.24	*	0.17	0.08	0.18	*
% Reduction school variance	89%				81%			
% Reduction pupil variance	16%				09%			
% Reduction total variance	34%				26%			

* p <0.05

Influences of Primary School Academic Effectiveness for Different Groups of Pupils

In this part of the report, the analyses explored differential influences of primary school academic effectiveness on pupils' cognitive attainment at Year 9. The combined term between parents' highest qualification and the academic effectiveness of the primary school attended were entered into multilevel models after controlling for individual pupil, family (excluding the parents' qualifications) and HLE measures. Due to the fact that forming multiple groups reduces the number of pupils in each group, we grouped the medium and highly effective primary schools together.

Parents' Qualification Level and the Impact of Primary School Academic Effectiveness

For these analyses, we used the *Parent's highest qualification* variable described previously. As we did not find an overall effect of the primary school academic effectiveness for the later attainment in English, the combined term between effectiveness and parents' qualification was only explored for mathematics and science outcomes.

For later attainment in mathematics, the primary school academic effectiveness was important for those of lower qualified parents. Compared to pupils who had attended low effective primary schools, pupils who had attended a highly (ES_{Orig}=0.33; $ES_{Imputed}$=0.34) or medium academically effective (ES_{Orig}=0.16; $ES_{Imputed}$=0.18) primary school have significantly higher mathematics TA levels in Year 9.

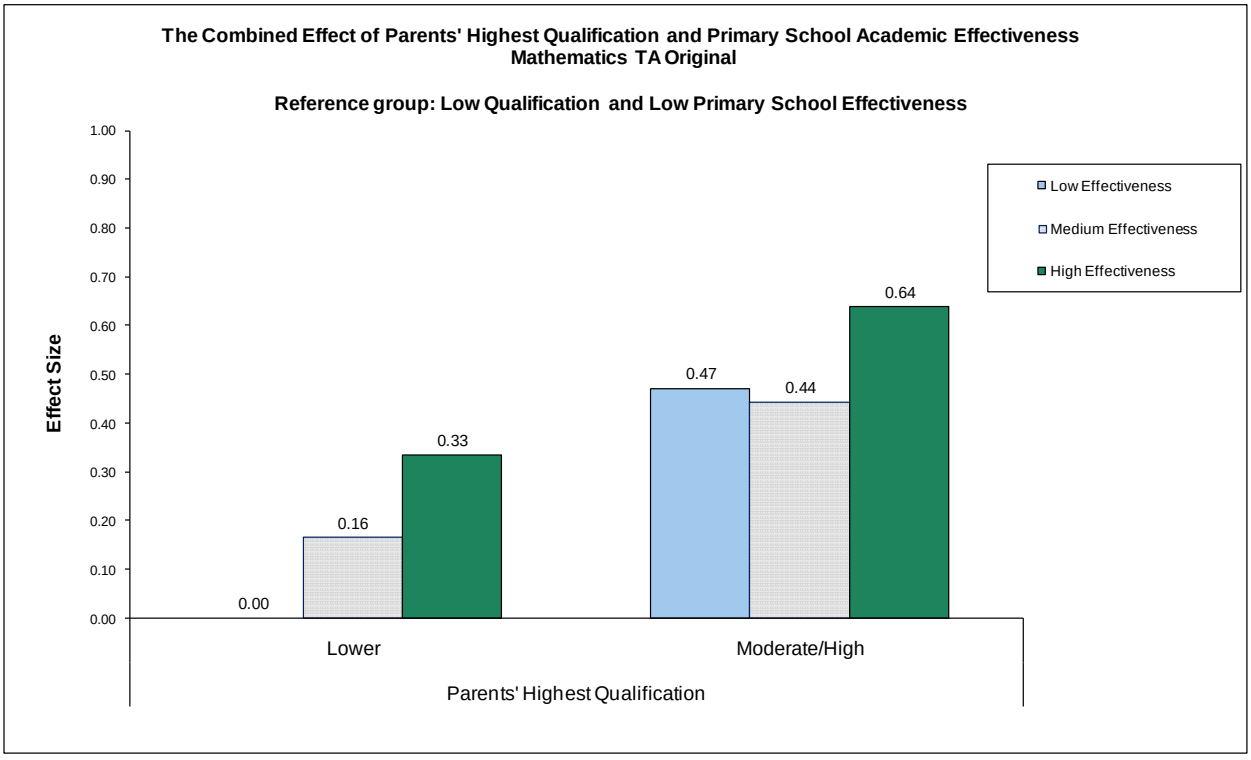
The relative effectiveness of the primary school was also important for pupils of parents with higher qualifications with effect sizes ranging from 0.47 to 0.64 (see Figure 3.22). The biggest benefit in increasing later cognitive outcome was experienced by the pupils who had attended a highly effective primary school.

Table 3.30: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Primary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2085**				**2347**			
Number of schools	**498**				**600**			
Fixed Effects	**Coef**	**SE**	**ES**	**S**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Primary School Academic Effectiveness (compared to Low effectiveness, Lower Qualification)								
Medium effectiveness, Lower Qualification	0.19	0.09	0.16	*	0.21	0.09	0.18	*
High effectiveness, Lower Qualification	0.39	0.13	0.33	*	0.40	0.13	0.34	*
Low effectiveness, Moderate/High Qualification	0.55	0.14	0.47	*	0.49	0.14	0.41	*
Medium effectiveness, Moderate/High Qualification	0.51	0.10	0.44	*	0.49	0.11	0.42	*
High effectiveness, Moderate/High Qualification	0.74	0.17	0.64	*	0.72	0.16	0.61	*
% Reduction school variance	77%				76%			
% Reduction pupil variance	14%				12%			
% Reduction total variance	26%				25%			

* p <0.05

Figure 3.22: The Combined Impact of Parents' Highest Qualification and Primary School Academic Effectiveness on Mathematics Teacher Assessment Levels in Year 9



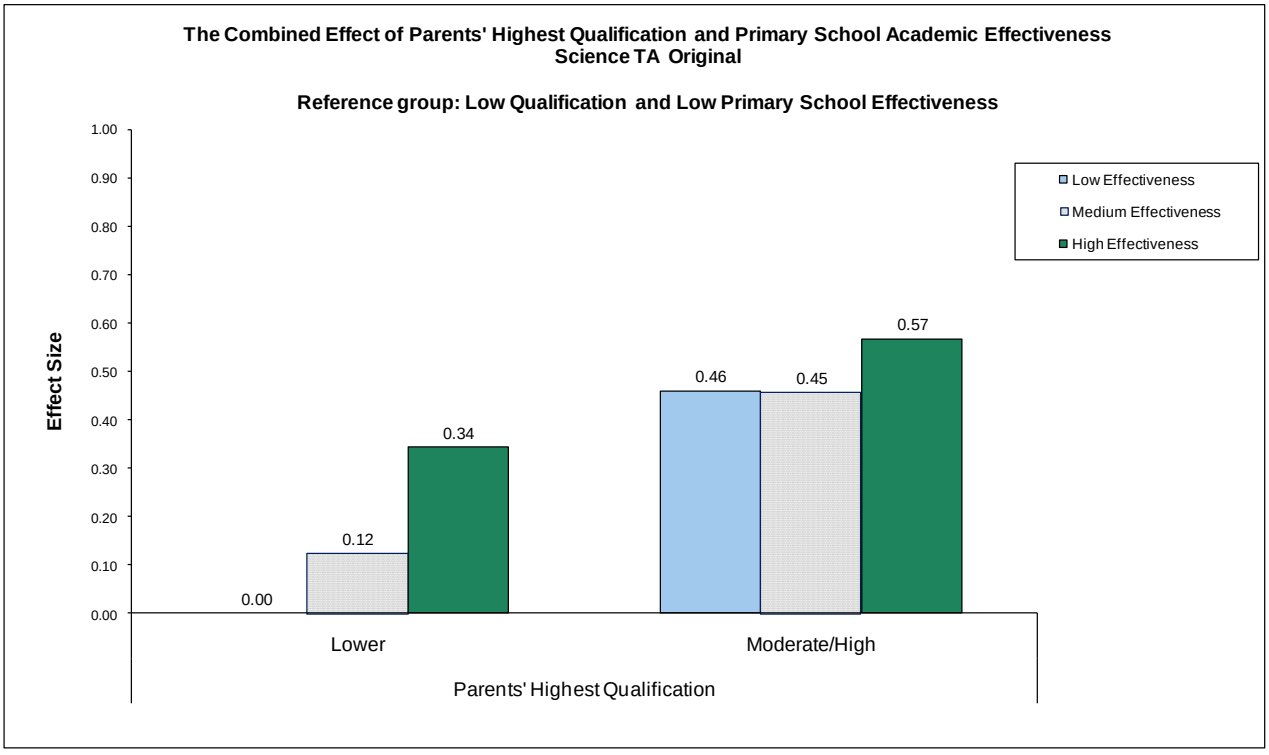
The results for attainment in science followed a similar pattern (see Figure 3.23). TA levels in science were greater for pupils whose parents had a higher qualification and had attended a highly effective primary school (ES_{Orig}=0.34; $ES_{Imputed}$=0.30). The differences in attainment between pupils with lower qualified parents and low academic effective primary school and pupils with higher qualified parents were the largest for those who had attended a highly effective primary school (ES_{Orig}=0.57; $ES_{Imputed}$=0.49).

Table 3.31: Contextualised Models for Science Teacher Assessment Levels in Year 9: Parents' Highest Qualification by Primary School Academic Effectiveness (Maths) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	2077				2347			
Number of schools	499				600			
Fixed Effects	**Coef**	**SE**	**ES**	**S**	**Coef**	**SE**	**ES**	**Sig**
Parents' Highest Qualification by Primary School Academic Effectiveness (compared to Low effectiveness, Lower Qualification)								
Medium effectiveness, Lower Qualification	0.11	0.07	0.12		0.11	0.07	0.11	
High effectiveness, Lower Qualification	0.32	0.10	0.34	*	0.29	0.10	0.30	*
Low effectiveness, Moderate/High Qualification	0.43	0.11	0.46	*	0.36	0.11	0.39	*
Medium effectiveness, Moderate/High Qualification	0.42	0.08	0.45	*	0.37	0.08	0.40	*
High effectiveness, Moderate/High Qualification	0.53	0.14	0.57	*	0.46	0.13	0.49	*
% Reduction school variance	81%				80%			
% Reduction pupil variance	13%				11%			
% Reduction total variance	29%				27%			

* p <0.05

Figure 3.23: The Combined Impact of Parents' Highest Qualification and Primary School Academic Effectiveness (Maths) on Science Teacher Assessment Levels in Year 9



The Combined Impact of Pre-School Experience and Primary School Academic Effectiveness

Given that the study has demonstrated both the importance of characteristics of pre-school experience and the impact of primary school academic effectiveness for long lasting positive effects on later cognitive attainment, their joint effects were also investigated in Year 9. We sought to establish whether going to a high quality or more effective pre-school had a protective influence if a child went on to a less effective primary school, and whether 'home' pupils, or those who went to a less effective or low quality pre-school, did better later if they went to a more effective primary school and whether these effects continued into secondary school.

We combined different pre-school measures and primary school academic effectiveness and incorporated them in the same model - controlling for background factors - to explore any joint effects of pre-school and primary school. For all three subjects, the reference group was 'no pre-school and low academically effective primary school'.

High academically effective primary school boosted later cognitive attainment regardless whether the child had attended or not a pre-school. However, these boosting effects were statistically significant only for mathematics and science, and did not reach significance level for English (see Table 3.32 - Table 3.33).

Table 3.32: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Attendance by Primary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2125**				**2347**			
Number of schools	**500**				**600**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Attendance by Primary School Academic Effectiveness (compared to No Pre-school and Low Effectiveness)								
No pre-school, High Effectiveness	0.46	0.21	0.40	*	0.55	0.22	0.47	*
Pre-school, Low Effectiveness	0.49	0.20	0.43	*	0.56	0.19	0.48	*
Pre-school, High Effectiveness	0.61	0.19	0.52	*	0.66	0.18	0.56	*
% Reduction school variance	76%				77%			
% Reduction pupil variance	15%				13%			
% Reduction total variance	27%				26%			

* p <0.05

Table 3.33: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Attendance by Primary School Academic Effectiveness (Maths) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2090**				**2347**			
Number of schools	**499**				**600**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Attendance by Primary School Academic Effectiveness (compared to No Pre-school and Low Effectiveness)								
No pre-school, High Effectiveness	0.65	0.17	0.71	*	0.58	0.16	0.62	*
Pre-school, Low Effectiveness	0.63	0.16	0.69	*	0.59	0.15	0.63	*
Pre-school, High Effectiveness	0.67	0.15	0.73	*	0.61	0.15	0.65	*
% Reduction school variance	81%				82%			
% Reduction pupil variance	15%				12%			
% Reduction total variance	31%				29%			

* p <0.05

We also combined the measure of pre-school quality (ECERS-E) with primary school academic effectiveness. We included these joint measures in the same multilevel model that also contained the individual pupil, family and HLE measures. Only the results for mathematics and science are presented as for English, the combined term of pre-school quality and primary school academic effectiveness was not statistically significant (see Table 3.34-Table 3.35; Figure 3.24-Figure 3.25).

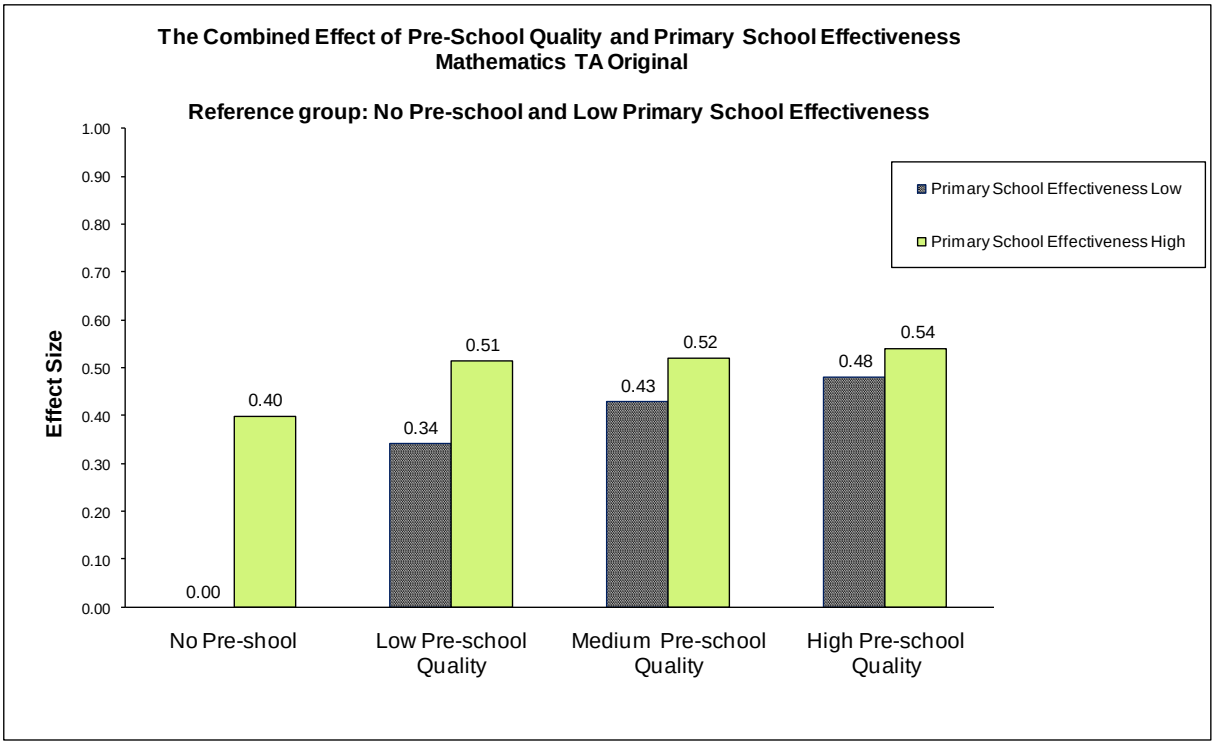
For mathematics, the quality of the pre-school attended still shows a protective function for those pupils who attended a low academically effective primary school. Thus, pupils who had attended a high quality pre-school but later went to a low academically effective primary school had greater TA levels (ES_{Orig}=0.48; $ES_{Imputed}$=0.54) in mathematics than those who had not attended any pre-school but later had attended a low academically effective primary school. Similarly for medium quality pre-schools; the difference in attainment between pupils who had not attended a pre-school and a low academically effective primary school and pupils who had not attended a pre-school but then went to a medium academically effective primary school was statistically significant and positive in favour for the later group (ES_{Orig}=0.43; $ES_{Imputed}$=0.48). Pupils who had attended a moderate to high academically effective primary school performed significantly better, regardless of the pre-school's quality, than those who had not attended any pre-school and in a primary school of low academic effectiveness (see Figure 3.24).

Table 3.34: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Quality (ECERS-E) by Primary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2125**				**2347**			
Number of schools	**500**				**600**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Quality by Primary School Academic Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Quality, Low Effectiveness	0.40	0.24	0.34		0.44	0.24	0.38	
Medium Quality, Low Effectiveness	0.50	0.21	0.43	*	0.57	0.20	0.48	*
High Quality, Low Effectiveness	0.56	0.23	0.48	*	0.63	0.22	0.54	*
No pre-school, High Effectiveness	0.46	0.21	0.40	*	0.55	0.22	0.47	*
Low Quality, High Effectiveness	0.60	0.20	0.51	*	0.63	0.20	0.54	*
Medium Quality, High Effectiveness	0.60	0.19	0.52	*	0.66	0.19	0.56	*
High Quality, High Effectiveness	0.63	0.20	0.54	*	0.67	0.19	0.57	*
% Reduction school variance	76%				77%			
% Reduction pupil variance	15%				13%			
% Reduction total variance	27%				26%			

* p <0.05

Figure 3.24: The Combined Impact of Pre-school Quality (ECERS-E) and Primary School Academic Effectiveness on Mathematics Teacher Assessment Levels in Year 9



For Science, the protective influences of pre-school were more noticeable; regardless of the attended pre-school's quality, pupils who continued their education in low academically effective[24] primary school performed as well as those who continued in moderate or high academically effective primary school, indicating that attending a pre-school still predicted better cognitive attainment in different subjects and for a long period of time (see Figure 3.25).

Also, primary school had a statistically significant positive influence on the cognitive attainment of those pupils who had not attended any pre-school. For both mathematics and science, pupils who went to a high academically effective primary school but had not attended a pre-school obtained significantly higher TA levels than those who went to a low academically effective primary school and did not go to a pre-school (mathematics: ES_{Orig}=0.40; $ES_{Imputed}$=0.47; science: ES_{Orig}=0.71; $ES_{Imputed}$=0.61).

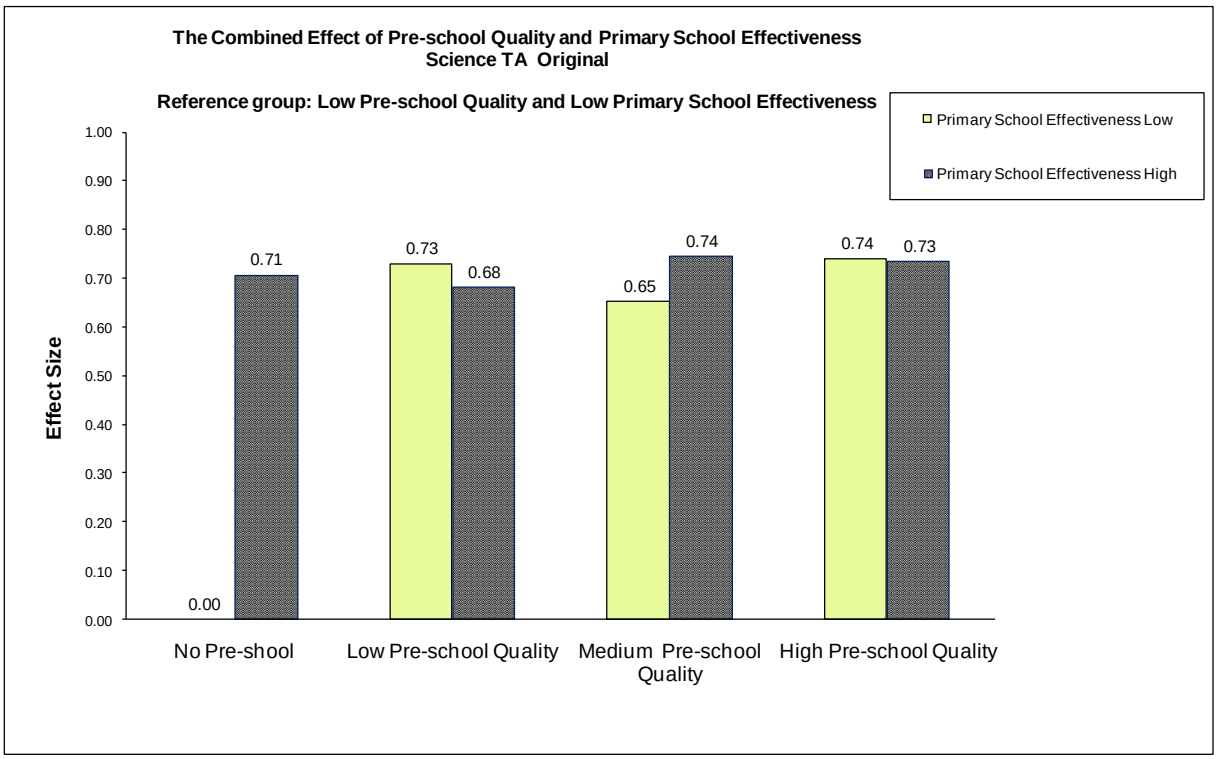
[24] It should be noted that the measure of primary school academic effectiveness tested related to Mathematics and not Science.

Table 3.35: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Quality (ECERS-E) by Primary School Academic Effectiveness (Maths) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2090**				**2347**			
Number of schools	**499**				**600**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Quality by Primary School Academic Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Quality, Low Effectiveness	0.67	0.20	0.73	*	0.63	0.19	0.67	*
Medium Quality, Low Effectiveness	0.60	0.17	0.65	*	0.55	0.16	0.59	*
High Quality, Low Effectiveness	0.68	0.19	0.74	*	0.65	0.18	0.70	*
No pre-school, High Effectiveness	0.65	0.17	0.71	*	0.58	0.16	0.61	*
Low Quality, High Effectiveness	0.62	0.16	0.68	*	0.54	0.16	0.57	*
Medium Quality, High Effectiveness	0.68	0.15	0.74	*	0.62	0.15	0.66	*
High Quality, High Effectiveness	0.67	0.16	0.73	*	0.61	0.15	0.65	*
% Reduction school variance	81%				82%			
% Reduction pupil variance	15%				12%			
% Reduction total variance	31%				29%			

* p <0.05

Figure 3.25: The Combined Impact of Pre-school Quality (ECERS-E) and Primary School Academic Effectiveness (Maths) on Science Teacher Assessment Levels in Year 9



The Combined Impact of Pre-School Effectiveness and Primary School Academic Effectiveness

In addition to the analyses of the individual impact of pre- and primary school academic effectiveness, these two measures were taken together so that the combined effects could be explored. The questions were whether going to a more effective pre-school had a protective influence if a child went on to a less effective primary school, and whether 'home' pupils or those who went to a less effective pre-school centre did better later if they went to a more effective primary school. Only the results for mathematics and science are presented as for English the combined term of pre-school effectiveness and primary school academic effectiveness was not statistically significant (see Table 3.36 and Table 3.37; Figure 3.26 and Figure 3.27). The reference group for these analyses were pupils with no pre-school experience who attended a low academically effective primary school.

Figure 3.26 and Figure 3.27 show for both mathematics and science that the pupils who were educated in low academically effective primary schools but had previously attended pre-school were still benefiting from that pre-school experience in Year 9. Their cognitive attainment in mathematics and science were gradated by the level of pre-school effectiveness. Thus, the highest attainment of the pupils educated in low academically effective primary schools was obtained by those who had attended a highly effective pre-school when compared to those from similar primary schools with no pre-school experiences (mathematics: ES_{Orig}=0.63; $ES_{Imputed}$=0.70; science: ES_{Orig}=0.99; $ES_{Imputed}$=0.92). These highly attaining group of pupils from low effective primary schools were then followed in decreasing order by those who had attended medium effective pre-schools and then by those who attended low effective pre-school.

Pupils who continued their education in high academic effective primary schools had similar levels of attainment regardless of the level of pre-school effectiveness when compared to those from low academic effective primary schools with no pre-school. The clear benefit of attending high academically effective primary school was shown for pupils who did not have any pre-school experiences. For attainment in both mathematics and science, pupils who went to a high academically effective primary school but had not attended a pre-school obtained significantly higher TA levels in Year 9 than those who had attended to a low academically effective primary school and did not go to a pre-school (mathematics: ES_{Orig}=0.40; $ES_{Imputed}$=0.47; science: ES_{Orig}=0.71; $ES_{Imputed}$=0.61).

Table 3.36: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Early Number Concepts) by Primary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	2125				2347			
Number of schools	500				600			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness by Primary School Academic Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Effectiveness, Low Effectiveness	0.32	0.25	0.28		0.35	0.24	0.30	
Medium Pre-school Effectiveness, Low Effectiveness	0.47	0.20	0.41	*	0.54	0.20	0.46	*
High Pre-school Effectiveness, Low Effectiveness	0.73	0.25	0.63	*	0.82	0.24	0.70	*
No pre-school, High Effectiveness	0.46	0.21	0.40	*	0.54	0.22	0.47	*
Low Pre-school Effectiveness, High Effectiveness	0.69	0.21	0.60	*	0.71	0.20	0.61	*
Medium Pre-school Effectiveness, High Effectiveness	0.57	0.19	0.49	*	0.62	0.19	0.53	*
High Pre-school Effectiveness, High Effectiveness	0.65	0.20	0.57	*	0.71	0.19	0.61	*
% Reduction school variance	76%				77%			
% Reduction pupil variance	15%				13%			
% Reduction total variance	27%				26%			

* p <0.05

Figure 3.26: The Combined Impact of Pre-school Effectiveness (Early Number Concepts) and Primary School Academic Effectiveness on Mathematics Teacher Assessment Levels in Year 9

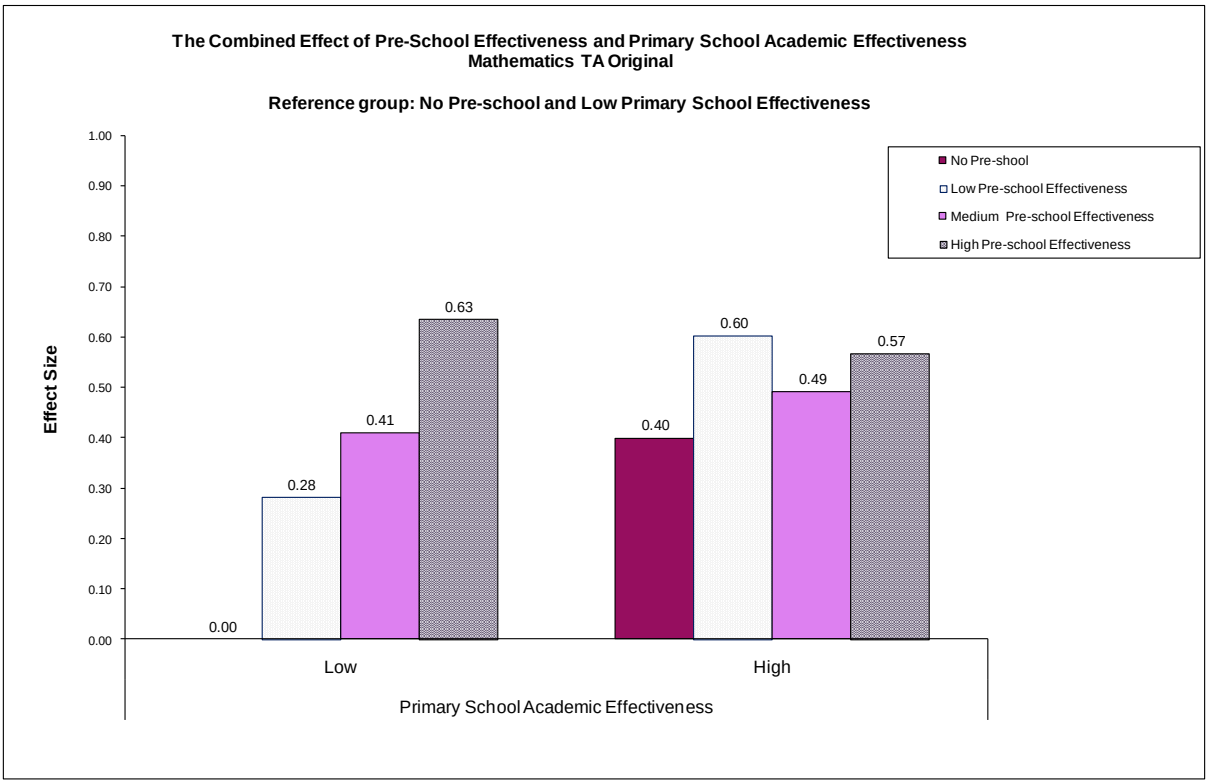
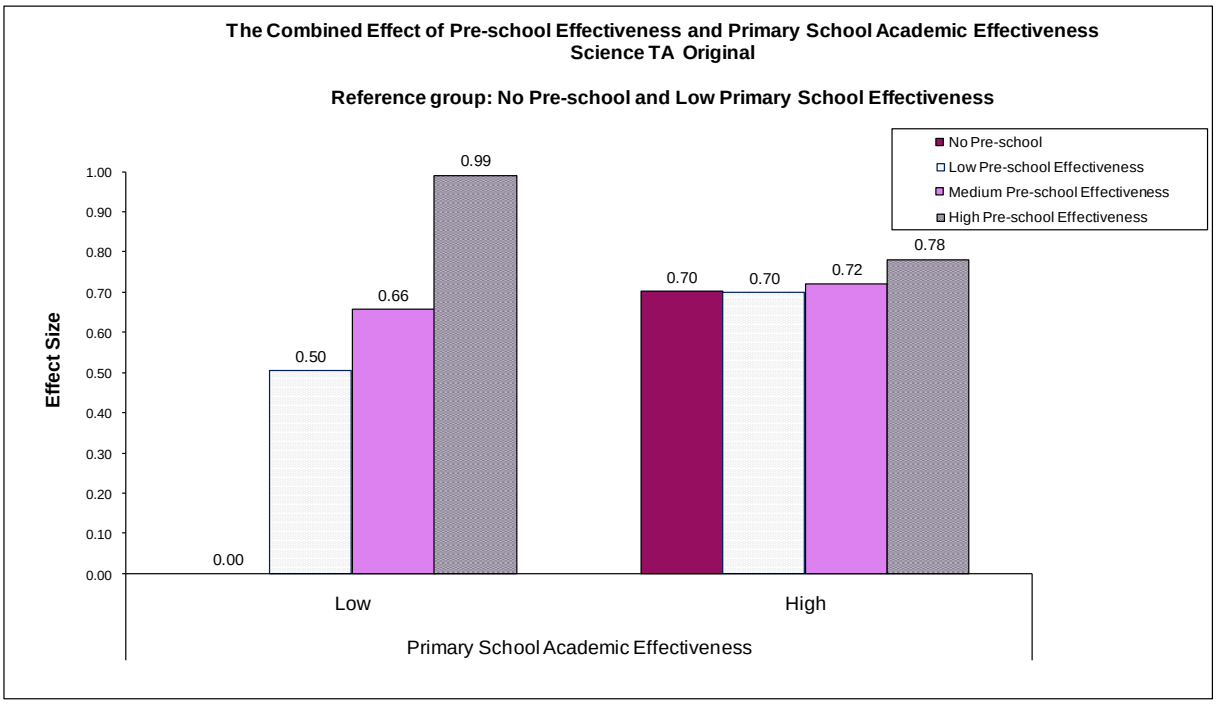


Table 3.37: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Early Number Concepts) by Primary School Academic Effectiveness (Maths) Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2090**				**2347**			
Number of schools	**499**				**600**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness by Primary School Academic Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Effectiveness, Low Effectiveness	0.46	0.20	0.50	*	0.42	0.19	0.44	*
Medium Pre-school Effectiveness, Low Effectiveness	0.60	0.16	0.66	*	0.57	0.16	0.61	*
High Pre-school Effectiveness, Low Effectiveness	0.91	0.20	0.99	*	0.86	0.20	0.92	*
No pre-school, High Effectiveness	0.64	0.17	0.70	*	0.57	0.16	0.61	*
Low Pre-school Effectiveness, High Effectiveness	0.64	0.17	0.70	*	0.55	0.16	0.59	*
Medium Pre-school Effectiveness, High Effectiveness	0.66	0.15	0.72	*	0.60	0.15	0.64	*
High Pre-school Effectiveness, High Effectiveness	0.72	0.16	0.78	*	0.65	0.15	0.70	*
% Reduction school variance	83%				83%			
% Reduction pupil variance	15%				12%			
% Reduction total variance	31%				29%			

* p <0.05

Figure 3.27: The Combined Impact of Pre-school Effectiveness (Early Number Concepts) and Primary School Academic Effectiveness (Maths) on Science Teacher Assessment Levels in Year 9



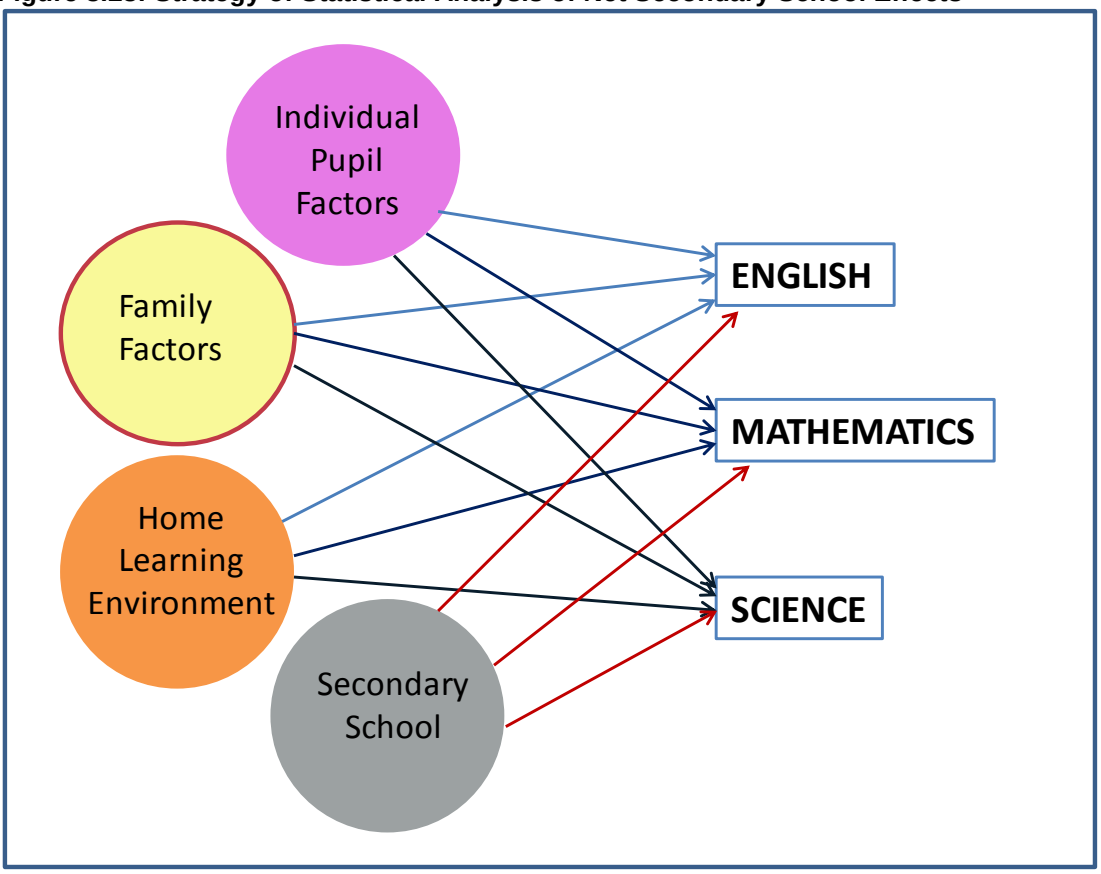
Overall, the findings extend earlier work conducted for the EPPSE sample up to age 11. These is evidence that the effectiveness of the pre-school continues to shape cognitive outcomes into lower secondary school and also that the academic quality of the primary school also shapes outcomes. Thus, the earlier educational experiences can offer longer term benefits to cognitive attainment.

3.3. The Impact of Secondary School on Year 9 Attainment

Analyses in the last section have shown that the academic effectiveness of the primary school predicts pupils' attainment in KS3 (particularly in mathematics and science) over and above that attributed to pupils' background. It is therefore important to establish whether secondary school effectiveness and educational quality also help to predict better student outcomes at age 14. In order to do this, national data sets have been used to obtain indicators of the level of secondary schools academic effectiveness and quality.

The measures of secondary school academic effectiveness and quality were added to the contextualised models that predicted attainment in Year 9 English, mathematics and science when controlling for individual pupil, family and HLE characteristics (see Figure 3.28 for the statistical analysis strategy).

Figure 3.28: Strategy of Statistical Analysis of Net Secondary School Effects



3.3.1. The Impact of Secondary School Academic Effectiveness on Year 9 Attainment

The secondary school academic overall effectiveness was represented by the contextual value added (CVA) score at the school level. This measure[25] was provided by the DfE and was matched into our data set based on the school identification number.
A mean CVA score was calculated based on KS2 to KS4 (KS2-4) CVA scores for four years from 2006 to 2009 for the secondary schools attended by EPPSE students. This measure was then incorporated into the multilevel models that predicted attainment in Year 9 English, Mathematics and Science when controlling for individual pupil, family and HLE characteristics.

We did not find a statistically significant overall effect of the secondary school academic effectiveness for any of the cognitive outcomes. It has to be noted that the secondary school academic effectiveness is a measure that was used as an overall progress across 5 years and did not relate to the KS3 period. Also, this measure might not relate in the same way with specific cognitive outcomes as a subject specific academic effectiveness (our earlier analyses on subject specific academic effectiveness measures at primary school indicated that this is relevant).

3.3.2. The Impact of Secondary School Quality on Year 9 Attainment

The quality of secondary schools was measured by Ofsted school level inspection judgements. These judgements cover four dimensions at the school level:

a) overall effectiveness,
b) achievement and standards,
c) personal development and well-being
d) quality of provision.

Secondary schools were given grades from 1 to 4, where Grade 1 meant that the secondary school was outstanding, Grade 2 – secondary school was good, Grade 3 – secondary school was satisfactory and Grade 4 – meaning that the secondary school was inadequate.

Since secondary schools are inspected in different years, we collected Ofsted inspection judgments from 2005 until 2010[26]. When a secondary school had several Ofsted inspection judgments, we considered the earliest one in time. The four dimensions mentioned were tested in the contextualised models that predicted cognitive attainment in Year 9, controlling for individual, family and HLE characteristics (see Appendix 9 for an exhaustive list of the tested Ofsted inspection judgments). Each inspection judgment was entered separately in the model so we avoid potential collinearity problems.

Only two Ofsted inspection judgments proved to be significant predictors of pupils' cognitive attainment in Year 9: *the quality of pupils' learning and their progress* (pertaining to the 'achievement and standards' dimension) and *the attendance of learners* (part of the 'personal development and well-being' dimension).

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[25] At the pupil level, the CVA score was calculated as the difference between predicted attainment (i.e., the average attainment achieved by similar pupils) and real attainment in KS4. The predicted attainment was obtained by using multi-level modelling when controlling for pupils' prior attainment and adjusting for their background characteristics (i.e., gender, age, ethnicity, special educational needs, FSM, mobility etc.). For each school, all individual pupil scores were averaged and adjusted for the proportion of pupils attending the school in a specific year. This final averaged score represents the school level CVA and it is presented as a number based around 1000 (for more technical details see http://www.education.gov.uk/performancetables/schools_08/documents.shtml).

[26] These were downloaded from the Ofsted homepage http://www.ofsted.gov.uk/

The Impact of the Quality of Pupils' Learning and Their Progress on Year 9 Attainment

Pupils attending secondary schools classified as outstanding based on the quality of pupils' learning had significantly better average results in English (ES_{Orig}=0.42; $ES_{Imputed}$=0.41), mathematics (ES_{Orig}=0.56; $ES_{Imputed}$=0.57) and science TA levels (ES_{Orig}=0.51; $ES_{Imputed}$=0.54) than pupils from secondary schools characterised as inadequate in their learning quality.

Additionally, pupils from secondary schools characterised as good or even satisfactory on learning quality performed significantly better in mathematics than pupils from inadequate secondary schools (see Table 3.39).

It is not surprising to find a strong relationship between the overall quality of learning in a specific secondary school and learning outcomes of its students; an outstanding provision leading to higher levels of attainment.

Table 3.38: Contextualised Models for English Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**533**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Quality of Pupils' Learning (compared to inadequate)								
Outstanding	0.34	0.11	0.42	*	0.35	0.12	0.41	*
Good	0.04	0.09	0.05		0.03	0.10	0.04	
Satisfactory	0.07	0.08	0.08		0.05	0.09	0.06	
Missing	0.08	0.12	0.10		-0.18	0.10	-0.21	
% Reduction school variance	81%				71%			
% Reduction pupil variance	25%				17%			
% Reduction total variance	38%				31%			

* p <0.05

Table 3.39: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Quality of Pupils' Learning (compared to inadequate)								
Outstanding	0.64	0.14	0.56	*	0.67	0.14	0.57	*
Good	0.29	0.11	0.26	*	0.28	0.12	0.24	*
Satisfactory	0.25	0.11	0.22	*	0.23	0.11	0.20	*
Missing	0.43	0.16	0.37	*	0.12	0.12	0.10	
% Reduction school variance	85%				82%			
% Reduction pupil variance	17%				12%			
% Reduction total variance	30%				27%			

* p <0.05

Table 3.40: Contextualised Models for Science Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Quality of Pupils' Learning (compared to inadequate)								
Outstanding	0.46	0.11	0.51	*	0.51	0.12	0.54	*
Good	0.15	0.09	0.16		0.17	0.10	0.18	
Satisfactory	0.06	0.08	0.07		0.07	0.09	0.07	
Missing	0.17	0.12	0.19		-0.10	0.10	-0.11	
% Reduction school variance	89%				83%			
% Reduction pupil variance	17%				10%			
% Reduction total variance	34%				27%			

* p <0.05

The Impact of the Learners' Attendance on Year 9 Attainment

Ofsted inspectors rated secondary schools based on the level of attendance of their pupils. Learners' attendance as rated by Ofsted inspectors was a statistically significant predictor of cognitive attainment in Year 9 in all three subjects. Pupils from secondary schools rated as outstanding on the learners' attendance got higher average levels in English (ES_{Orig}=0.70; $ES_{Imputed}$=0.64), mathematics (ES_{Orig}=0.71; $ES_{Imputed}$=0.69) and science TA (ES_{Orig}=0.56; $ES_{Imputed}$=0.54) than pupils from secondary schools characterised as inadequate in their overall attendance (see Table 3.41 - Table 3.43).

Additionally, pupils from secondary schools characterised as good or even satisfactory on attendance performed significantly better in English, mathematics and science than pupils from inadequate secondary schools.

The relationship between overall attendance and cognitive outcomes is interesting, but not straightforward. The positive strong relationship might be due to the fact that secondary schools that offer high quality academic provision have stricter policies on attendance and therefore are better attended, or are better attended because of the very quality of the provision. Additionally, we could not dismiss the benefits of higher levels of attendance on academic attainment. At this point, we could only speculate about these complex relationships.

Table 3.41: Contextualised Models for English Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**533**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Attendance of Learners (compared to inadequate)								
Outstanding	0.57	0.11	0.70	*	0.55	0.13	0.64	*
Good	0.44	0.10	0.53	*	0.39	0.11	0.45	*
Satisfactory	0.43	0.10	0.52	*	0.40	0.11	0.46	*
Missing	0.42	0.12	0.51	*	0.14	0.11	0.16	
% Reduction school variance	83%				73%			
% Reduction pupil variance	25%				17%			
% Reduction total variance	39%				31%			

* p <0.05

Table 3.42: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2996**			
Number of schools	**536**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Attendance of Learners (compared to inadequate)								
Outstanding	0.82	0.14	0.71	*	0.82	0.15	0.69	*
Good	0.60	0.12	0.52	*	0.59	0.13	0.50	*
Satisfactory	0.48	0.12	0.42	*	0.47	0.12	0.40	*
Missing	0.65	0.15	0.56	*	0.37	0.14	0.32	*
% Reduction school variance	90%				88%			
% Reduction pupil variance	17%				11%			
% Reduction total variance	30%				27%			

* p <0.05

Table 3.43: Contextualised Models for Science Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2996**			
Number of schools	**534**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Attendance of Learners (compared to inadequate)								
Outstanding	0.51	0.11	0.56	*	0.51	0.13	0.54	*
Good	0.36	0.10	0.40	*	0.36	0.11	0.38	*
Satisfactory	0.26	0.10	0.28	*	0.26	0.10	0.27	*
Missing	0.33	0.13	0.36	*	0.07	0.11	0.07	
% Reduction school variance	91%				85%			
% Reduction pupil variance	17%				10%			
% Reduction total variance	34%				27%			

* p <0.05

3.3.3. The Combined Impact of Pre-School Experience and Secondary School Academic Effectiveness

Even though we did not find a statistically significant overall effect of the secondary school academic effectiveness, it was important to explore whether features of the secondary school in combination with certain characteristics of the pre-school or primary school would have any influences on cognitive attainment in Year 9. We wanted to establish whether going to a high quality or more effective pre-school had a protective influence for pupils who later went to a less effective secondary school, and whether 'home' pupils, or those who went to a less effective or low quality pre-school, did better later if they went to a more effective secondary school.

Therefore, we combined different pre-school measures (i.e., quality and effectiveness) and secondary school academic effectiveness and incorporated them in the same model - controlling for background factors - to explore any joint effects of pre-school and secondary school. For all three subjects, the reference group was 'no pre-school and low academically effective secondary school'. The results of the combined effects between pre-school quality and secondary school academic effectiveness are presented in Table A.7.1 - Table A.7.3 in Appendix 7.

The benefits of pre-school quality for later attainment in English, mathematics and science are only visible only for those who were attending a medium effective secondary school in Year 9. The results for the other two groups (low and high effective secondary schools) are harder to interpret. The levels of attainment for this 'middle' group are gradated based on the quality of the attended pre-school. Thus, for all three subjects, pupils who had attended a low, medium or high quality pre-

school showed better attainment than those who had never attended a pre-school (given that they were all in a medium effective secondary school (see Figure A.7.1- Figure A.7.3 in Appendix 7).

The combined term between pre-school effectiveness and secondary school academic effectiveness show a similar pattern as the combined term between pre-school quality and secondary school effectiveness. However, the gradation in attainment based on pre-school effectiveness was visible not only for the medium effective secondary schools but also for the low effective secondary schools (see Figure A.7.4 and Figure A.7.6 in Appendix 7).

For all three subjects, the progression in attainment from no pre-school to highly effective pre-schools lead to increase in outcome in low effective secondary schools, pupils having attended a highly effective pre-school receiving the highest attainment levels when compared to pupils who had not attended any pre-school.

Similarly, this was the case for medium effective secondary schools. The differences in attainment from no pre-school and low secondary school effectiveness increased as the level of pre-school effectiveness improved, with the largest difference being for pupils who had attended highly effective pre-schools.

3.4. Summary of Pre-, Primary and Secondary School Influences

The contextualised multilevel models tested the net impact of different aspects of pre-, primary and secondary school experience while controlling for all other background measures simultaneously. These models provide rigorous and conservative estimates of statistical significance of any continuing pre- and primary school effects on later attainment in Year 9 as well as of secondary school influence.

The contextualised analyses show that good pre-school experience (in terms of high quality and high effectiveness) can still make a difference to pupils' longer term cognitive attainment even after 9 years full time in primary and secondary school education (for mathematics and science).

The results also illustrated that the academic effectiveness of the primary school also matters for attainment in mathematics and science in Year 9. A high academic effective primary school seems to be important for those pupils who did not go to pre-school (the lowest attainment are for the no pre-school group who went on to a low academically effective primary school). On the other hand attending high quality or more effective pre-school seems to act as a moderate to strong protective factor for pupils who go on to attend a less academically effective primary school.

No main effect was found for the secondary school academic effectiveness for any of the three academic subjects. However, the quality of the secondary school measured by the Ofsted inspection judgment proved to be significant predictor of cognitive attainment in Year 9. Pupils who attended outstanding secondary school as rated by the Ofsted inspectors in terms of attendance and quality of learning obtained significantly higher levels of TA in English, mathematics and science.

4. Exploring the Effects of School, Teaching Processes and Pupils' Views of Themselves on Later KS3 Attainment

During Year 9, students completed two questionnaires about their personal and academic life while in secondary school. One questionnaire ('All about me in school') focused on their academic life, specifically on their perceptions of the school, their teachers, headteachers and other pupils but also on their experiences as students in secondary schools. Based on this survey, several indicators were created reflecting school and teaching processes (for details see Sammons et al., 2011b).

The second questionnaire ('All about me') explored in more detail the personal, familial and the broader social context of the pupils while in secondary school. Interesting domains like 'out of school' learning along with the opportunities pupils have for additional learning experiences 'after hours', time spent on homework and they way they developed their own self academic concepts regarding different subjects were investigated.

It was hypothesised that all these various experiences might have an impact on the pupils' academic attainment. Therefore, we tested the indicators of school and teaching processes as predictors of the Year 9 cognitive outcomes measured by the TA levels in the multilevel models that controlled for individual pupil, family and HLE characteristics. These analyses provide an insight about the way secondary school experiences help to predict variation in students' cognitive outcomes in Year 9.

4.1. Teaching and School Processes

First, we explored the pupils' school related perceptions and experiences. Using Exploratory and Confirmatory Factor Analysis (EFA & CFA) several factors related to teaching and school processes were created (see Sammons et al., 2011b). These factors included:

- Emphasis on learning
- Behaviour climate
- Headteacher
- School environment
- Valuing pupils
- School/Learning resources
- Teacher behavioural management
- Teacher support

These factors were tested as separate predictors of the Year 9 cognitive outcomes in multilevel models that also included various individual pupil, familial and HLE characteristics (described as important in Sections 2 and 3). For each cognitive outcome a number of school factors were found to be statistically significant. Originally, the items that entered in the composition of any of the factors were Likert type scale that went from (1) strongly agree to (4) strongly disagree. These were reversed in order to make the interpretation easier. The factors were treated as continuous measures and were centred to the grand mean. Only the factors that were significant predictors of Year 9 cognitive attainment are presented.

4.1.1. Emphasis on Learning

Emphasis on learning describes the perceived expectations that teachers have regarding their pupils' learning, but also the pupils' expectations regarding their own attainment. A higher emphasis on learning was a significant predictor of better attainment measured by TA levels in English (ES_{Orig}=0.21; $ES_{Imputed}$=0.21), mathematics (ES_{Orig}=0.22; $ES_{Imputed}$=0.21) and science (ES_{Orig}=0.20; $ES_{Imputed}$=0.16). In terms of gain in academic attainment, higher emphasis on learning

was associated with an increase of half of a TA level in English and science and more than three quarters of a TA level in mathematics.

Table 4.1: Contextualised Models for English Teacher Assessment Levels in Year 9: Emphasis on Learning (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE[27]			
Number of pupils	**1460**				**2632**			
Number of schools	**387**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.51	0.14	0.21	*	0.55	0.16	0.21	*
% Reduction school variance	85%				83%			
% Reduction pupil variance	29%				22%			
% Reduction total variance	43%				38%			

* p <0.05

Table 4.2: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Emphasis on Learning (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**1475**				**2632**			
Number of schools	**387**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.77	0.19	0.22	*	0.76	0.19	0.21	*
% Reduction school variance	89%				85%			
% Reduction pupil variance	21%				14%			
% Reduction total variance	34%				29%			

* p <0.05

Table 4.3: Contextualised Models for Science Teacher Assessment Levels in Year 9: Emphasis on Learning (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**1463**				**2632**			
Number of schools	**387**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.54	0.15	0.20	*	0.46	0.17	0.16	*
% Reduction school variance	87%				88%			
% Reduction pupil variance	22%				15%			
% Reduction total variance	37%				32%			

* p <0.05

4.1.2. Behaviour Climate

Behaviour climate refers to the specific (disruptive) behaviours that pupils notice around the school (e.g., obeying rules, fighting, bringing into schools knives or weapons). Higher scores on this factor reflect a more positive behaviour climate[28]. The results of the multilevel models predicting academic attainment indicated that the TA levels in English, mathematics and science were higher for pupils who perceived their secondary schools' behaviour climate as more positive than those who rated the behaviour climate of their schools less favourably (see Table 4.4 and Table 4.6). The ES for mathematics and science were larger than for English.

[27] These analyses are based on a further imputation model that incorporated additional measures of pupils' self-perceptions.

[28] Pupils rate their school more positively in terms of the extent of disruptive behaviours

These results are in accord with previous school effectiveness research that points to the importance of the school's overall behaviour climate (see Creemers & Kyriakides, 2008; Rutter et al., 1979; Sammons, Thomas, & Mortimore, 1997; Scheerens & Bosker, 1997).

Table 4.4: Contextualised Models for English Teacher Assessment Levels in Year 9: Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**1461**				**2632**			
Number of schools	**387**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Behaviour Climate (continuous)	0.31	0.07	0.28	*	0.37	0.07	0.32	*
% Reduction school variance	86%				84%			
% Reduction pupil variance	29%				23%			
% Reduction total variance	43%				38%			

* p <0.05

Table 4.5: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**1476**				**2632**			
Number of schools	**387**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Behaviour Climate (continuous)	0.72	0.09	0.46	*	0.79	0.09	0.50	*
% Reduction school variance	89%				87%			
% Reduction pupil variance	21%				17%			
% Reduction total variance	34%				32%			

* p <0.05

Table 4.6: Contextualised Models for Science Teacher Assessment Levels in Year 9: Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**1464**				**2632**			
Number of schools	**387**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Behaviour Climate (continuous)	0.45	0.08	0.37	*	0.52	0.08	0.41	*
% Reduction school variance	89%				89%			
% Reduction pupil variance	23%				17%			
% Reduction total variance	38%				33%			

* p <0.05

4.1.3. School Environment

The school environment measure represents the perceived quality of the physical environment of the secondary school (i.e., attractive building, decoration of the classroom, level of cleanness of the toilets) but also the level of organisation. The environment in which teaching and learning take place is found to predict the pupils' academic attainment. Thus, pupils who perceived their school's environment as pleasant and attractive achieved better TA levels than those who did not. The school environment was found to be a statistically significant predictor of TA levels in both mathematics and science but it was not significantly related to the English TA levels (see Table 4.7-Table 4.8).

Table 4.7: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: School Environment (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1476				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
School Environment (continuous)	0.29	0.13	0.13	*	0.13	0.14	0.06	
% Reduction school variance	89%				84%			
% Reduction pupil variance	21%				13%			
% Reduction total variance	34%				38%			

* p <0.05

Table 4.8: Contextualised Models for Science Teacher Assessment Levels in Year 9: School Environment (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1464				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
School Environment (continuous)	0.23	0.10	0.13	*	0.12	0.11	0.07	
% Reduction school variance	86%				88%			
% Reduction pupil variance	21%				14%			
% Reduction total variance	37%				31%			

* p <0.05

4.1.4. Valuing Pupils

Another domain that predicted the academic outcome was pupils' perceptions of the degree in which their teachers valued and respected them. Higher scores on this factor reflect higher perceived levels of respect and friendliness from the teachers. The more the teachers were perceived as valuing pupils' views and opinions, the higher the academic outcome in mathematics (ES_{Orig}=0.12; $ES_{Imputed}$=0.09^{ns}) and science (ES_{Orig}=0.14; $ES_{Imputed}$=0.09^{ns}), although positive, the ES were small. As with all self-perception measures, it is not possible to make causal connections since the directionality of relationships may be reciprocal. Pupils with higher attainment may have more positive perceptions of their teachers. Additionally, teachers who value their pupils could also put more effort in the teaching and learning and therefore increase academic attainment. Regardless of the specific directionality, it is important for the teachers to recognise that the way they relate and present themselves to the pupils may influence their cognitive outcome.

Table 4.9: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Valuing Pupils (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1477				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Valuing Pupils (continuous)	0.24	0.11	0.12	*	0.20	0.11	0.09	
% Reduction school variance	89%				84%			
% Reduction pupil variance	21%				14%			
% Reduction total variance	34%				28%			

* p <0.05

Table 4.10: Contextualised Models for Science Teacher Assessment Levels in Year 9: Valuing Pupils (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1465				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Valuing Pupils (continuous)	0.22	0.09	0.14	*	0.16	0.09	0.09	
% Reduction school variance	86%				88%			
% Reduction pupil variance	21%				14%			
% Reduction total variance	37%				31%			

* p <0.05

4.1.5. School/Learning Resources

The schools' capacity to offer good learning resources is likely to influence the way pupils learn and acquire new information. Amenities like good science labs, libraries and computer rooms were directly associated with cognitive outcome, especially in mathematics and science. Again, higher scores on learning resources meant that the pupils perceived that the school was well equipped with computers and technology and that there was enough time in using these facilities. Pupils' perceptions of available learning resources significantly predicted higher TA levels in mathematics and science (see Table 4.11 and Table 4.12), although the ES were small and significantly only in the original data. Thus, pupils' cognitive attainment in mathematics and science increased with half of a level when more learning resources were available.

Table 4.11: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Learning Resources (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1477				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Learning Resources (continuous)	0.50	0.21	0.13	*	0.23	0.23	0.06	
% Reduction school variance	90%				83%			
% Reduction pupil variance	20%				20%			
% Reduction total variance	34%				36%			

* p <0.05

Table 4.12: Contextualised Models for Science Teacher Assessment Levels in Year 9: Learning Resources (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1464				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Learning Resources (continuous)	0.46	0.17	0.15	*	0.25	0.17	0.08	
% Reduction school variance	88%				88%			
% Reduction pupil variance	21%				14%			
% Reduction total variance	37%				31%			

* p <0.05

4.1.6. Emphasis on Learning and Behaviour Climate

After testing each of the eight factors derived from the Year 9 pupil survey separately as predictors of attainment, we also tested them together to investigate which ones are the most important in predicting cognitive outcomes in Year 9 when still controlling for individual pupil, familial and HLE characteristics. Because the factors were correlated the question of multicolliniarity arises. For all three core curriculum subjects, it was found that the two factors 'Emphasis on learning' and 'Behaviour climate' together significantly predicted Year 9 cognitive attainment. Additionally, it when tested together the factor 'behaviour climate' is found to be the stronger predictor of cognitive attainment. Also, for mathematics, the ES is slightly larger than the ES found in the equivalent analyses for English and science TA levels (ES_{Orig}=0.43; $ES_{Imputed}$=0.47) as can be seen in Table 4.14. For attainment in all areas a stronger Emphasis on learning and a more positive rating of their school's behaviour climate – as they were perceived by pupils – significantly predicted better attainment in all three subjects.

Table 4.13: Contextualised Models for English Teacher Assessment Levels in Year 9: Emphasis on Learning and Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	1459				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.39	0.14	0.16	*	0.44	0.16	0.17	*
Behaviour Climate (continuous)	0.26	0.07	0.23	*	0.34	0.07	0.29	*
% Reduction school variance	85%				84%			
% Reduction pupil variance	30%				23%			
% Reduction total variance	43%				39%			

* p <0.05

Table 4.14: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Emphasis on Learning and Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1477				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.45	0.19	0.13	*	0.52	0.19	0.15	*
Behaviour Climate (continuous)	0.66	0.10	0.43	*	0.75	0.09	0.47	*
% Reduction school variance	92%				88%			
% Reduction pupil variance	23%				18%			
% Reduction total variance	36%				33%			

* p <0.05

Table 4.15: Contextualised Models for Science Teacher Assessment Levels in Year 9: Emphasis on Learning and Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1462				2632			
Number of schools	387				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.33	0.15	0.12	*	0.31	0.16	0.11	
Behaviour Climate (continuous)	0.41	0.08	0.33	*	0.50	0.08	0.39	*
% Reduction school variance	88%				89%			
% Reduction pupil variance	23%				17%			
% Reduction total variance	38%				34%			

* p <0.05

These results again point to the importance of the secondary school's behaviour climate as an important feature of effectiveness, and this supports the findings of previous research on secondary schools (e.g., Rutter et al., 1979; Sammons, Thomas & Mortimore, 1997).

4.2. Time Spent on Homework

Pupils' self reports of time spent on homework was positively linked to higher TA levels for all three subjects, the biggest effect sizes were obtained for the category '2-3 hours'. The relationship between time spent on homework and TA levels followed an incremental gradation up to 2-3 hours. Spending more than 3 hours on homework did not offer extra benefits for attainment in this analysis. The highest benefit of studying for 2-3 hours was found for science (ES_{Orig}=0.85; $ES_{Imputed}$=0.65), followed by mathematics (ES_{Orig}=0.84; $ES_{Imputed}$=0.71) and finally for English (ES_{Orig}=0.73; $ES_{Imputed}$=0.65). Studying for more than 3 hours significantly predicted higher TA levels in English and mathematics, but only for the original data.

Time spent on homework was one of the strongest predictors of attainment even when pupils' background was controlled. Time spent on homework may reflect teachers' expectations and the schools' academic emphasis as well as the students' own motivation and engagement. Our findings are in line with previous research on the homework and academic achievement relationship (Cooper et al., 2006).

Table 4.16: Contextualised Models for English Teacher Assessment Levels in Year 9: Time Spent on Homework (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2632**			
Number of schools	**533**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Time Spent on Homework (compared to none) Less than ½ hour	0.34	0.11	0.41	*	0.23	0.11	0.27	*
½-1 hour	0.27	0.10	0.34	*	0.26	0.10	0.31	*
1-2 hours	0.33	0.11	0.40	*	0.36	0.11	0.43	*
2-3 hours	0.59	0.14	0.73	*	0.55	0.14	0.65	*
Over 3 hours	0.57	0.27	0.70	*	0.39	0.23	0.46	
Missing	0.04	0.10	0.05					
% Reduction school variance	81%				83%			
% Reduction pupil variance	26%				22%			
% Reduction total variance	39%				38%			

* *p* <0.05

Table 4.17: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Time Spent on Homework (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2500**				**2632**			
Number of schools	**536**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Time Spent on Homework (compared to none) Less than ½ hour	0.39	0.15	0.35	*	0.24	0.14	0.21	
½-1 hour	0.40	0.14	0.35	*	0.36	0.14	0.31	*
1-2 hours	0.56	0.15	0.49	*	0.55	0.14	0.48	*
2-3 hours	0.95	0.20	0.84	*	0.82	0.19	0.71	*
Over 3 hours	0.76	0.38	0.68	*	0.65	0.36	0.56	
Missing	0.06	0.14	0.06					
% Reduction school variance	89%				85%			
% Reduction pupil variance	19%				15%			
% Reduction total variance	31%				29%			

* *p* <0.05

Table 4.18: Contextualised Models for Science Teacher Assessment Levels in Year 9: Time Spent on Homework (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2465**				**2632**			
Number of schools	**534**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Time Spent on Homework (compared to none)								
Less than ½ hour	0.27	0.12	0.31	*	0.17	0.11	0.19	
½-1 hour	0.29	0.11	0.33	*	0.24	0.11	0.26	*
1-2 hours	0.42	0.12	0.47	*	0.37	0.13	0.41	*
2-3 hours	0.76	0.16	0.85	*	0.59	0.17	0.65	*
Over 3 hours	0.39	0.30	0.44		0.33	0.29	0.36	
Missing	0.04	0.11	0.05					
% Reduction school variance	90%				89%			
% Reduction pupil variance	18%				15%			
% Reduction total variance	35%				32%			

* p <0.05

4.3. Pupils' Views of Themselves

Based on the 'All about me' questionnaire, the following indicators were created (see Sammons et al., 2011b report for the technical details of obtaining these factors):

- Mathematics Academic Self-Concept
- English Academic Self-Concept
- Enjoyment of School
- Popularity
- Citizen Values
- Anxiety Behaviours

These factors were entered separately as predictors of the Year 9 cognitive outcomes in multilevel models that also included individual pupil, familial and HLE characteristics. For each cognitive outcome, different school factors were significant. Lower scores on these factors indicate higher degrees of agreement with the items that entered in the composition of the specific factor. Similarly with the indicators of the teaching and school processes, these factors were also treated as continuous measures and were centred to the grand mean. Only the factors that were significant predictors of Year 9 cognitive attainment are presented.

4.3.1. Mathematics and English Academic Self-Concepts

Pupils own perceptions of their abilities in Math and English were highly predictive of cognitive attainment in Year 9. As expected, the academic self-concept in maths was the strongest predictor of the mathematics TA levels (ES_{Orig}=1.15; $ES_{Imputed}$=1.02). This was also a strong predictor of science (ES_{Orig}=0.76; $ES_{Imputed}$=0.68) and English TA levels (ES_{Orig}=0.47; $ES_{Imputed}$=0.51). Similarly, the English academic self-concept was the strongest predictor of the English TA levels (ES_{Orig}=0.74; $ES_{Imputed}$=0.66).

In interpreting these findings, it should be noted that academic self-concept is likely to be strongly influenced by earlier and current attainment and the links are reciprocal (Marsh & O'Mara, 2008).

The mathematics academic self concept was a better predictor of English TA levels (ES_{Orig}=0.47; $ES_{Imputed}$=0.51 than the English academic self-concept predicting mathematics TA levels (ES_{Orig}=0.23; $ES_{Imputed}$=0.31). Moreover, the academic self-concept in maths was a stronger predictor of the science TA levels (ES_{Orig}=0.76; $ES_{Imputed}$=0.68) than the academic self-concept in English predicting the same cognitive outcome - science (ES_{Orig}=0.38; $ES_{Imputed}$=0.39).

These findings are in line with previous research that showed that self-concept effects on academic achievement tended to be greater and more systematic for mathematics than for science and, particularly, English (Marsh & Yeung, 1997).

Table 4.19: Contextualised Models for English Teacher Assessment Levels in Year 9: Maths Academic Self-Concept (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	1458				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Maths Academic Self-Concept (continuous)	0.30	0.04	0.47	*	0.34	0.04	0.51	*
% Reduction school variance	85%				83%			
% Reduction pupil variance	32%				26%			
% Reduction total variance	45%				40%			

* p <0.05

Table 4.20: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Maths Academic Self-Concept (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1475				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Maths Academic Self-Concept (continuous)	0.91	0.04	1.15	*	0.86	0.04	1.02	*
% Reduction school variance	85%				85%			
% Reduction pupil variance	40%				30%			
% Reduction total variance	49%				42%			

* p <0.05

Table 4.21: Contextualised Models for Science Teacher Assessment Levels in Year 9: Maths Academic Self-Concept (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1461				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Maths Academic Self-Concept (continuous)	0.51	0.04	0.76	*	0.48	0.03	0.68	*
% Reduction school variance	87%				90%			
% Reduction pupil variance	31%				22%			
% Reduction total variance	44%				38%			

* p <0.05

Table 4.22: Contextualised Models for English Teacher Assessment Levels in Year 9: English Academic Self-Concept (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	1458				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
English Academic Self-Concept (continuous)	0.55	0.04	0.74	*	0.51	0.04	0.66	*
% Reduction school variance	88%				85%			
% Reduction pupil variance	36%				28%			
% Reduction total variance	49%				43%			

* p <0.05

Table 4.23: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: English Academic Self-Concept (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1474				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
English Academic Self-Concept (continuous)	0.24	0.06	0.23	*	0.34	0.05	0.31	*
% Reduction school variance	87%				84%			
% Reduction pupil variance	22%				15%			
% Reduction total variance	34%				29%			

* p <0.05

Table 4.24: Contextualised Models for Science Teacher Assessment Levels in Year 9: English Academic Self-Concept (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1460				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
English Academic Self-Concept (continuous)	0.32	0.05	0.38	*	0.34	0.04	0.39	*
% Reduction school variance	83%				88%			
% Reduction pupil variance	25%				17%			
% Reduction total variance	39%				33%			

* p <0.05

4.3.2. Enjoyment of School

The degree to which pupils enjoyed their school was a statistically significant predictor of their attainment in Year 9. Pupils who liked being at school or found the school as a friendly place were also more likely to obtain higher TA levels in English (ES_{Orig}=0.29; $ES_{Imputed}$=0.22), mathematics (ES_{Orig}=0.38; $ES_{Imputed}$=0.28) and science (ES_{Orig}=0.31; $ES_{Imputed}$=0.23).

Again in interpreting these results, it should be noted that these relationships are reciprocal. Enjoyment may be influenced by academic success and vice versa.

Table 4.25: Contextualised Models for English Teacher Assessment Levels in Year 9: Enjoyment of School (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	1468				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Enjoyment of School (continuous)	0.47	0.09	0.29	*	0.39	0.08	0.22	*
% Reduction school variance	87%				83%			
% Reduction pupil variance	30%				22%			
% Reduction total variance	43%				38%			

* p <0.05

Table 4.26: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Enjoyment of School (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1484				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Enjoyment of School (continuous)	0.85	0.12	0.38	*	0.67	0.11	0.28	*
% Reduction school variance	89%				84%			
% Reduction pupil variance	23%				15%			
% Reduction total variance	36%				29%			

* p <0.05

Table 4.27: Contextualised Models for Science Teacher Assessment Levels in Year 9: Enjoyment of School (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1471				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Enjoyment of School (continuous)	0.56	0.10	0.31	*	0.43	0.09	0.23	*
% Reduction school variance	87%				88%			
% Reduction pupil variance	22%				15%			
% Reduction total variance	38%				32%			

* p <0.05

4.3.3. Anxiety Behaviours

Anxious behaviour was a negative predictor of cognitive outcome. As might be anticipated, students who rated themselves more highly in terms of anxiety had poorer attainment levels (see Table 4.28 and Table 4.30). Anxiety had its strongest negative effect on attainment in mathematics (ES_{Orig}=-0.29; $ES_{Imputed}$=-0.16), more anxious pupils losing almost half of TA level when compared to less anxious pupils.

Table 4.28: Contextualised Models for English Teacher Assessment Levels in Year 9: Anxiety (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	1460				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Anxiety (continuous)	-0.18	0.07	-0.15	*	-0.09	0.06	-0.07	
% Reduction school variance	86%				81%			
% Reduction pupil variance	29%				21%			
% Reduction total variance	43%				37%			

* p <0.05

Table 4.29: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Anxiety (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1477				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Anxiety (continuous)	-0.48	0.09	-0.29	*	-0.28	0.08	-0.16	*
% Reduction school variance	90%				85%			
% Reduction pupil variance	22%				14%			
% Reduction total variance	35%				28%			

* p <0.05

Table 4.30: Contextualised Models for Science Teacher Assessment Levels in Year 9: Anxiety (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1463				2632			
Number of schools	388				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Anxiety (continuous)	-0.30	0.07	-0.23	*	-0.19	0.07	-0.14	*
% Reduction school variance	86%				88%			
% Reduction pupil variance	23%				15%			
% Reduction total variance	38%				31%			

* p <0.05

5. Exploring Relative Cognitive Progress between Year 6 and Year 9

Young pupils' cognitive progress was investigated over the pre-school period, from age 3 years plus to primary school entry (Sammons et al., 2002). The results were used to identify measures of pre-school centre effects, based on value added analyses, tested in earlier sections of this report in relation to attainment at the end of Year 9.

Further analyses of progress were reported between Year 1 and Year 5 (Sammons et al., 2007a) and then between Year 2 and Year 6 of primary education (Sammons et al., 2008a). In this section, we explore the EPPSE pupils' academic progress from the end of Year 6 at primary school to the end of Year 9 at secondary school using TA levels as cognitive outcomes and Year 6 National Assessment test scores as measures of prior attainment. The assessments at the end of Year 6 provide the baseline measures for these analyses of pupil progress. The results of the simple value added models control only for prior cognitive attainment at the end of Year 6 for prediction of later attainment in English, mathematics and science at the end of Year 9.

The results indicate that more of the total variance in mathematics TA levels in Year 9 was accounted for by prior attainment at the end of Year 6 (71%) than is the case for English (58%) or science TA levels (54%). The results indicated that around 10 to 11 per cent of the variation in progress is accounted for by the secondary school attended (see Table 5.2 - Table 5.4).

The variation in pupils' progress associated with their school is shown by the intra-school correlation (ICC) an overall indicator of potential differences in school effectiveness. It is possible that any variation between schools, in terms of progress, might reflect differences in teaching approaches and emphases during KS3.

Table 5.1 shows the estimates for the cognitive attainment at the end of Year 6 measured by National Assessments when predicting English, mathematics and science TA at the end of Year 9. Prior attainment in English was considered to be relevant for later attainment in English, with an estimate of 0.04, while the prior attainment in mathematics was relevant for later attainment in mathematics, with an estimate of 0.07. When tested individually, the prior attainment in mathematics proved to be a stronger predictor for later attainment in science (estimate=0.05) than the prior attainment in English (estimate=0.04). This is also the case when both prior attainment are tested together in predicting later science TA levels.

Table 5.1: Multilevel Model Estimates of Prior Attainment Measures on Year 9 attainment in English, Mathematics and Science Outcomes – Original Data

	English TA (Year 9) Estimate (se)	**Mathematics TA (Year 9)** Estimate (se)	**Science TA (Year 9)** Estimate (se)
Intercept	0.60*** (0.097)	Not tested	0.87***(0.11)
English (Year 6) Standardised Score	0.05*** (0.001)		0.04*** (0.001)
Intercept	Not tested	-1.53*** (0.10)	0.50*** (0.10)
Mathematics (Year 6) Standardised Score		0.072*** (0.001)	0.05*** (0.001)
Intercept	Not tested	Not tested	-0.19 (0.11)
English (Year 6) Standardised Score			0.02*** (0.001)
Mathematics (Year 6) Standardised Score			0.03*** (0.001)

*** p <0.001

Table 5.2: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2416**				**3002**			
Number of schools	**550**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Year 6 English Test Score	0.05	0.00	2.09	*	0.05	0.00	2.12	*
% Reduction school variance	82%				80%			
% Reduction pupil variance	51%				45%			
% Reduction total variance	58%				54%			
Intra-school correlation (ICC)	0.1057				0.1142			

* p <0.05

Table 5.3: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2424**				**3002**			
Number of schools	**553**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Year 6 Maths Test Score	0.07	0.00	3.06	*	0.07	0.00	2.91	*
% Reduction school variance	82%				82%			
% Reduction pupil variance	68%				63%			
% Reduction total variance	71%				67%			
Intra-school correlation (ICC)	0.1133				0.1165			

* p <0.05

Table 5.4: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

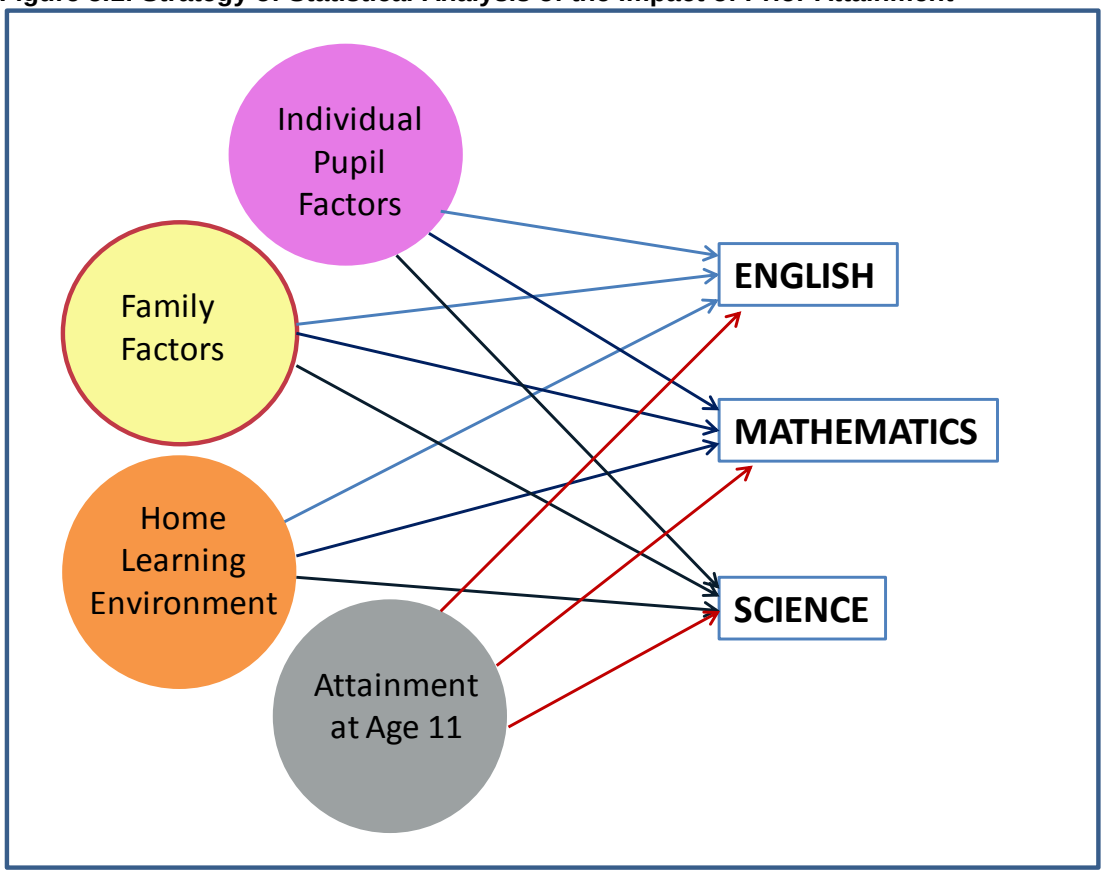
	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2427**				**3002**			
Number of schools	**554**				**800**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Year 6 Maths Test Score	0.05	0.00	1.98	*	0.05	0.00	1.91	*
% Reduction school variance	78%				83%			
% Reduction pupil variance	46%				62%			
% Reduction total variance	54%				66%			
Intra-school correlation (ICC)	0.1102				0.1083			

* p <0.05

5.1. The Impact of Individual Pupil, Family and Home Learning Environment (HLE) characteristics

After the simple value added analyses, further contextualised value added analyses were undertaken to explore whether the individual pupil, family and HLE characteristics, found to be significant predictors of later cognitive attainment differences at the end of Year 9, were also associated with differential academic progress between primary and secondary school (see Figure 5.1 for an illustration).

Figure 5.1: Strategy of Statistical Analysis of the Impact of Prior Attainment



The findings indicated that older pupils compared to younger pupils (ES_{Orig}=0.24; $ES_{Imputed}$=0.20), girls compared to boys (ES_{Orig}=0.32; $ES_{Imputed}$=0.25), pupils with older mothers (ES_{Orig}=0.13; $ES_{Imputed}$=0.09), pupils' whose family's income was very high (ES_{Orig}=0.39; $ES_{Imputed}$=0.21^{ns}), pupils who have highly qualified mothers (ES_{Orig}=0.34 or $ES_{Imputed}$=0.22 for mothers with degree/high degree compared to no qualification) or fathers (ES_{Orig}=0.28 or $ES_{Imputed}$=0.19^{ns} for fathers with degree/high degree compared to no qualification) and that pupils who had a medium KS2 HLE (ES_{Orig}=0.16; $ES_{Imputed}$=0.10^{ns}) made significantly better progress in English. On the other hand, pupils whose parents reported one or more early behavioural problems in the pre-school period (ES_{Orig}=-0.15; $ES_{Imputed}$=-0.14 compared to no behavioural problems), pupils eligible or receiving FSM (ES_{Orig}=-0.19; $ES_{Imputed}$=-0.17 as compared to no FSM), pupils from schools that have a higher proportion of FSM students (ES_{Orig}=-0.18; $ES_{Imputed}$=-0.14) made significantly less progress during secondary school education. For the detailed ES see Table 5.5.

Table 5.5: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	2341				2996			
Number of schools	518				799			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.00	0.24	*	0.02	0.00	0.20	*
Year 6 English Test Score	0.04	0.00	1.89	*	0.04	0.00	1.93	*
Gender (compared to boys)	0.20	0.03	0.32	*	0.17	0.03	0.25	*
Birth weight (compared to normal)								
Very Low Weight	-0.06	0.12	-0.09		-0.15	0.12	-0.22	
Low Birth Weight	0.00	0.05	0.00		-0.02	0.06	-0.03	
Missing	0.14	0.12	0.23					
Ethnic groups (compared to White UK Heritage)								
White European	0.08	0.08	0.13		0.05	0.08	0.07	
Black Caribbean	-0.09	0.08	-0.14		-0.13	0.08	-0.18	
Black African	0.06	0.10	0.09		0.06	0.11	0.09	
Other Ethnic Minority	0.01	0.09	0.02		-0.04	0.10	-0.06	
Indian	0.12	0.11	0.19		0.04	0.11	0.06	
Pakistani	0.06	0.09	0.10		0.02	0.09	0.03	
Bangladeshi	0.28	0.16	0.45		0.16	0.15	0.24	
Mixed Heritage	0.01	0.06	0.01		-0.04	0.06	-0.06	
Early Developmental Problems (compared to none)								
1+ Developmental Problem	-0.02	0.04	-0.03		-0.05	0.05	-0.07	
Missing	-0.18	0.73	-0.29					
Early Behavioural Problems (compared to none)								
1 + Behavioural Problem	-0.09	0.04	-0.15	*	-0.09	0.05	-0.14	*
Number of Siblings (compared to none)								
1 sibling	0.02	0.04	0.04		0.05	0.04	0.07	
2 siblings	-0.02	0.04	-0.03		0.01	0.05	0.01	
3 or more siblings	-0.08	0.05	-0.13		-0.06	0.05	-0.09	
Missing	0.38	0.27	0.60					
Mother's Age	0.06	0.02	0.13	*	0.04	0.02	0.09	*
FSM in Year 9 (compared to none)								
Eligible for FSM	-0.12	0.04	-0.19	*	-0.12	0.04	-0.17	*
Missing	-0.02	0.20	-0.03					
Family Salary (compared to 'no salary')								
2,500 – 15,000	-0.004	0.05	-0.01		-0.01	0.04	-0.01	
17,500 – 27,500	0.01	0.05	0.02		0.05	0.05	0.07	
30,000 – 37,000	0.06	0.06	0.09		0.07	0.06	0.10	
37,500– 66,000	0.05	0.05	0.08		0.07	0.06	0.10	
+67,500	0.25	0.09	0.39	*	0.14	0.09	0.21	
Missing	0.07	0.05	0.10					
Family Socio Economic Status (compared to the Highest)								
Other professional non manual	-0.004	0.07	-0.01		0.01	0.06	0.02	
Skilled non manual	0.002	0.07	0.00		-0.01	0.07	-0.02	
Skilled manual	-0.004	0.08	-0.01		-0.01	0.08	-0.02	
Semi skilled	0.06	0.08	0.10		0.00	0.09	0.00	
Unskilled	0.07	0.11	0.11		0.05	0.12	0.07	
Unemployed: not working	0.12	0.11	0.19		0.05	0.11	0.07	
Missing	-0.37	0.24	-0.59					
Mother's Qualification (compared to none)								
Vocational	0.07	0.05	0.11		0.04	0.05	0.06	
Academic age 16	0.10	0.04	0.16	*	0.08	0.04	0.11	
Academic age 18	0.13	0.06	0.20	*	0.12	0.06	0.17	
Degree or Higher Degree	0.21	0.07	0.34	*	0.15	0.07	0.22	*
Other professional / Miscellaneous	0.12	0.12	0.19		0.05	0.13	0.07	
Missing	0.07	0.13	0.11					
Father's Qualification (compared to none)	-0.01	0.05	-0.01		-0.02	0.06	-0.02	

Vocational								
Academic age 16	0.05	0.05	0.08		0.03	0.04	0.05	
Academic age 18	0.13	0.06	0.20	*	0.07	0.07	0.10	
Degree or Higher Degree	0.17	0.06	0.28	*	0.13	0.07	0.19	
Other professional / Miscellaneous	0.25	0.14	0.40		0.18	0.14	0.26	
Absent Father	-0.03	0.05	-0.05					
Missing	-0.48	0.29	-0.76					
Early Years HLE (compared to 0 – 13)								
14 – 19	-0.07	0.05	-0.12		-0.02	0.06	-0.03	
20 – 24	-0.08	0.06	-0.13		-0.04	0.06	-0.06	
25 – 32	-0.03	0.06	-0.05		0.02	0.06	0.03	
33 – 45	-0.10	0.07	-0.16		-0.02	0.07	-0.02	
Missing	0.04	0.11	0.06					
KS1 HLE Enrichment Outings (compared to low)								
Medium KS1 HLE	0.06	0.04	0.09		0.03	0.05	0.05	
High KS1 HLE	0.10	0.06	0.17		0.06	0.07	0.09	
KS2 HLE Educational Computing (compared to low)								
Medium KS2 HLE	0.10	0.03	0.16	*	0.07	0.04	0.10	
High KS2 HLE	0.05	0.05	0.07		0.04	0.06	0.06	
FSM school level	-0.004	0.001	-0.18	*	0.00	0.00	-0.14	*
% White British	-0.002	0.001	-0.16	*	0.00	0.00	-0.13	*
Intercept	1.00	0.14			0.82	0.15		
Log restricted-likelihood	-2404.39							
Random Effects								
School variance	0.03		0.01		0.04			
Residual variance	0.40		0.01		0.47			
Intra-school correlation (ICC)	0.0736				0.0970			
Null model								
School variance	0.28		0.04		0.31			
Residual variance	0.89		0.03		0.89			
Intra-school correlation (ICC)	0.2397				0.2588			
% Reduction school variance	89%				85%			
% Reduction pupil variance	56%				48%			
% Reduction total variance	64%				57%			

* p <0.05

For mathematics, the results showed that older pupils compared to younger pupils (ES_{Orig}=0.32; $ES_{Imputed}$=0.24), girls compared to boys (ES_{Orig}=0.16; $ES_{Imputed}$=0.12), pupils of other ethnic minority (ES_{Orig}=0.31; $ES_{Imputed}$=0.25^{ns}) or of Bangladeshi background (ES_{Orig}=0.88; $ES_{Imputed}$=0.62) and that pupils who have highly qualified fathers (ES_{Orig}=0.28 or $ES_{Imputed}$=0.13^{ns} for fathers with degree/high degree compared to no qualification) made greater gains in terms of progress during secondary school. However, pupils whose parents reported one or more early behavioural problems in the pre-school period (ES_{Orig}=-0.14; $ES_{Imputed}$=-0.17 compared to no behavioural problems) and pupils eligible or receiving FSM (ES_{Orig}=-0.19; $ES_{Imputed}$=-0.17 as compared to no FSM) made significantly less progress in mathematics (see Table 5.6).

Table 5.6: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2384**				**2996**			
Number of schools	**522**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Age	0.03	0.00	0.32	*	0.02	0.00	0.24	*
Year 6 Maths Test Score	0.07	0.00	2.99	*	0.07	0.00	2.79	*
Gender (compared to boys)	0.11	0.03	0.16	*	0.09	0.03	0.12	*
Birth weight (compared to normal)								
Very Low Weight	-0.07	0.13	-0.10		-0.12	0.14	-0.16	
Low Birth Weight	-0.06	0.06	-0.09		-0.01	0.06	-0.01	
Missing	0.10	0.13	0.15					
Ethnic groups (compared to White UK Heritage)								
White European	0.07	0.09	0.10		0.08	0.09	0.11	
Black Caribbean	-0.02	0.09	-0.03		-0.07	0.09	-0.10	
Black African	0.08	0.11	0.11		0.06	0.12	0.08	
Other Ethnic Minority	0.21	0.10	0.31	*	0.19	0.12	0.25	
Indian	-0.01	0.11	-0.01		0.05	0.12	0.07	
Pakistani	0.16	0.10	0.24		0.17	0.11	0.22	
Bangladeshi	0.60	0.17	0.88	*	0.46	0.18	0.62	*
Mixed Heritage	0.05	0.07	0.08		0.06	0.07	0.08	
Early Developmental Problems (compared to none)								
1+ Developmental Problem	0.00	0.05	0.00		-0.04	0.05	-0.05	
Missing	0.01	0.43	0.02					
Early Behavioural Problems (compared to none)								
1 + Behavioural Problem	-0.10	0.05	-0.14	*	-0.13	0.05	-0.17	*
Number of Siblings (compared to none)								
1 sibling	-0.03	0.04	-0.04		-0.01	0.04	-0.01	
2 siblings	-0.02	0.04	-0.02		0.00	0.05	0.00	
3 or more siblings	-0.09	0.05	-0.14		-0.07	0.05	-0.10	
Missing	-0.57	0.26	-0.82	*				
FSM in Year 9 (compared to none)								
Eligible for FSM	-0.13	0.04	-0.19	*	-0.13	0.05	-0.17	*
Missing	-0.36	0.22	-0.52					
Family Salary (compared to 'no salary')								
2,500 – 15,000	0.05	0.05	0.07		0.02	0.06	0.03	
17,500 – 27,500	0.06	0.05	0.09		0.08	0.05	0.11	
30,000 – 37,000	0.09	0.06	0.14		0.07	0.07	0.10	
37,500– 66,000	0.08	0.06	0.11		0.07	0.06	0.10	
+67,500	0.05	0.10	0.08		0.03	0.11	0.04	
Missing	-0.06	0.05	-0.09					
Family Socio Economic Status (compared to the Highest)								
Other professional non manual	0.06	0.07	0.09		0.02	0.08	0.02	
Skilled non manual	0.01	0.08	0.02		-0.04	0.08	-0.05	
Skilled manual	0.04	0.08	0.05		-0.04	0.09	-0.06	
Semi skilled	0.03	0.09	0.04		-0.08	0.09	-0.10	
Unskilled	0.05	0.12	0.08		-0.02	0.13	-0.02	
Unemployed: not working	0.22	0.12	0.31		0.06	0.13	0.08	
Missing	-0.17	0.23	-0.24					
Mother's Qualification (compared to none)								
Vocational	0.04	0.06	0.05		0.01	0.06	0.02	
Academic age 16	0.09	0.05	0.13	*	0.06	0.05	0.08	
Academic age 18	0.12	0.07	0.18		0.10	0.08	0.14	
Degree or Higher Degree	0.13	0.07	0.19		0.11	0.08	0.15	
Other professional / Miscellaneous	0.02	0.13	0.04		0.06	0.15	0.09	
Missing	0.05	0.13	0.08					

Father's Qualification (compared to none)								
Vocational	0.13	0.06	0.18	*	0.06	0.07	0.07	
Academic age 16	0.09	0.05	0.14		0.05	0.05	0.07	
Academic age 18	0.17	0.07	0.24	*	0.09	0.07	0.12	
Degree or Higher Degree	0.19	0.07	0.28	*	0.10	0.08	0.13	
Other professional / Miscellaneous	0.20	0.15	0.29		0.11	0.16	0.15	
Absent Father	0.01	0.05	0.01					
Missing	0.23	0.31	0.33					
Early Years HLE (compared to 0 – 13)								
14 – 19	0.001	0.06	0.001		0.04	0.07	0.06	
20 – 24	-0.05	0.06	-0.07		-0.01	0.07	-0.01	
25 – 32	0.03	0.06	0.05		0.10	0.07	0.13	
33 – 45	0.02	0.07	0.03		0.09	0.08	0.12	
Missing	0.02	0.11	0.001				0.07	
KS2 HLE Educational Computing (compared to low)								
Medium KS2 HLE	0.05	0.03	0.002		0.05	0.05	-0.01	
High KS2 HLE	-0.02	0.06	-0.04		-0.01	0.07	-0.10	
FSM school level	-0.0030	0.0015	-0.13		-0.0025	0.0017	0.00	
% White British	-0.0012	0.0010	-0.08		0.0000	0.0011	0.06	
Intercept	-1.38	0.16			-1.18	0.16		
Log restricted-likelihood		-2660.29						
Random Effects								
School variance	0.04		0.02		0.06			
Residual variance	0.47		0.04		0.56			
Intra-school correlation (ICC)	0.0860				0.0975			
Null model								
School variance	0.36		0.06		0.42			
Residual variance	1.58		0.05		1.56			
Intra-school correlation (ICC)	0.1887				0.2103			
% Reduction school variance	88%				85%			
% Reduction pupil variance	70%				64%			
% Reduction total variance	73%				69%			

* p <0.05

As the relationship between Year 9 science TA levels and Year 6 Mathematics test scores was stronger than with Year 6 English test scores, the prior attainment in Mathematics was included in the value added models.

For the attainment in science, it was found that older pupils compared to younger pupils (ES_{Orig}=0.20; $ES_{Imputed}$=0.15), girls compared to boys (ES_{Orig}=0.17; $ES_{Imputed}$=0.14), White European pupils (ES_{Orig}=0.38; $ES_{Imputed}$=0.26) or of Bangladeshi origin (ES_{Orig}=0.54; $ES_{Imputed}$=0.47^{ns}), pupils with older mothers (ES_{Orig}=0.15; $ES_{Imputed}$=0.09), pupils who have highly qualified mothers (ES_{Orig}=0.33 or $ES_{Imputed}$=0.26 for mothers with degree/high degree compared to no qualification) or fathers (ES_{Orig}=0.43 or $ES_{Imputed}$=0.21 for fathers with degree/high degree compared to no qualification) and that pupils who had a medium KS2 HLE (ES_{Orig}=0.10; $ES_{Imputed}$=0.11^{ns}) made significantly better progress in science in secondary school (see Table 5.7).

A few categories of pupils made significantly less progress during secondary school: pupils eligible or receiving FSM (ES_{Orig}=-0.15; $ES_{Imputed}$=-0.16 as compared to no FSM) and pupils from schools that have a higher proportion of FSM students (ES_{Orig}=-0.21; $ES_{Imputed}$=-0.15).

These results confirm the findings indentified at younger ages for the EPPSE sample in both pre-school and primary school and show the continued impact of such background factors in shaping both pupils' attainment and progress in different phases of education.

Table 5.7: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2350**				**2996**			
Number of schools	**520**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.00	0.20	*	0.02	0.00	0.15	*
Year 6 Maths Test Score	0.04	0.00	1.79	*	0.04	0.00	1.76	*
Gender (compared to boys)	0.12	0.03	0.17	*	0.11	0.03	0.14	*
Birth weight (compared to normal)								
Very Low Weight	-0.12	0.13	-0.17		-0.09	0.13	-0.12	
Low Birth Weight	0.07	0.06	0.11		0.03	0.06	0.04	
Missing	0.14	0.13	0.20					
Ethnic groups (compared to White UK Heritage)								
White European	0.27	0.09	0.38	*	0.20	0.09	0.26	*
Black Caribbean	-0.13	0.09	-0.18		-0.17	0.09	-0.22	
Black African	-0.02	0.11	-0.03		0.02	0.13	0.03	
Other Ethnic Minority	0.20	0.10	0.29	*	0.23	0.11	0.31	*
Indian	0.07	0.12	0.10		0.03	0.11	0.04	
Pakistani	0.15	0.09	0.22		0.10	0.09	0.13	
Bangladeshi	0.38	0.18	0.54	*	0.35	0.19	0.47	
Mixed Heritage	0.03	0.07	0.04		-0.01	0.08	-0.02	
Early Developmental Problems (compared to none)								
1+ Developmental Problem	-0.01	0.05	-0.01		-0.07	0.05	-0.09	
Missing	-0.60	0.82	-0.85					
Mother's Age	0.08	0.02	0.15	*	0.05	0.03	0.09	*
FSM in Year 9 (compared to none)								
Eligible for FSM	-0.11	0.05	-0.15	*	-0.12	0.05	-0.16	*
Missing	-0.12	0.22	-0.16					
Family Salary (compared to 'no salary')								
2,500 – 15,000	-0.01	0.05	-0.01		-0.03	0.05	-0.04	
17,500 – 27,500	0.00	0.06	0.00		0.01	0.05	0.02	
30,000 – 37,000	-0.02	0.06	-0.02		0.00	0.07	0.00	
37,500– 66,000	0.00	0.06	0.00		0.00	0.06	0.01	
+67,500	0.11	0.10	0.15		0.00	0.09	0.00	
Missing	-0.04	0.05	-0.05					
Family Socio Economic Status (compared to the Highest)								
Other professional non manual	-0.01	0.07	-0.01		0.01	0.09	0.01	
Skilled non manual	-0.06	0.08	-0.08		-0.06	0.10	-0.08	
Skilled manual	-0.07	0.09	-0.10		-0.08	0.10	-0.10	
Semi skilled	-0.03	0.09	-0.05		-0.08	0.11	-0.10	
Unskilled	-0.01	0.12	-0.02		-0.04	0.15	-0.05	
Unemployed: not working	0.01	0.12	0.01		-0.02	0.13	-0.03	
Missing	-0.29	0.27	-0.41					
Mother's Qualification (compared to none)								
Vocational	0.18	0.06	0.26	*	0.17	0.07	0.23	*
Academic age 16	0.16	0.05	0.23	*	0.13	0.05	0.17	*
Academic age 18	0.24	0.07	0.35	*	0.24	0.08	0.31	*
Degree or Higher Degree	0.23	0.07	0.33	*	0.20	0.07	0.26	*
Other professional / Miscellaneous	0.23	0.13	0.33		0.21	0.14	0.28	
Missing	0.13	0.15	0.18					
Father's Qualification (compared to none)								
Vocational	0.16	0.06	0.23	*	0.07	0.05	0.09	
Academic age 16	0.20	0.05	0.28	*	0.11	0.05	0.14	*
Academic age 18	0.26	0.07	0.37	*	0.13	0.07	0.17	
Degree or Higher Degree	0.30	0.07	0.43	*	0.16	0.07	0.21	*
Other professional / Miscellaneous	0.21	0.16	0.30		0.07	0.17	0.09	
Absent Father	0.13	0.05	0.18	*				
Missing	-0.10	0.37	-0.14					

Early Years HLE (compared to 0 – 13)								
14 – 19	-0.05	0.06	-0.07		-0.03	0.06	-0.04	
20 – 24	0.00	0.06	0.00		0.00	0.06	0.00	
25 – 32	0.04	0.06	0.06		0.05	0.07	0.07	
33 – 45	0.12	0.07	0.17		0.11	0.08	0.14	
Missing	-0.20	0.12	-0.28					
KS1 HLE Enrichment Outings (compared to low)								
Medium KS1 HLE	0.01	0.04	0.02		-0.02	0.05	-0.03	
High KS1 HLE	0.01	0.07	0.02		-0.03	0.07	-0.04	
KS2 HLE Individual Activities (compared to low)								
Medium KS2 HLE	0.07	0.03	0.10	*	0.09	0.05	0.11	
High KS2 HLE	0.09	0.06	0.12		0.10	0.07	0.13	
FSM school level	0.00	0.00	-0.21	*	0.00	0.00	-0.15	*
% White British	-0.001	0.001	-0.09		-0.001	0.001	-0.03	
Intercept	0.77	0.16			0.80	0.18		
Log restricted-likelihood	-2650.67							
Random Effects								
School variance	0.03		0.01		0.04			
Residual variance	0.50		0.02		0.58			
Intra-school correlation (ICC)	0.0513				0.0703			
Null model								
School variance	0.30		0.04		0.03			
Residual variance	0.99		0.03		1.00			
Intra-school correlation (ICC)	0.2366				0.2330			
% Reduction school variance	91%				86%			
% Reduction pupil variance	50%				42%			
% Reduction total variance	59%				52%			

* p <0.05

Additionally, some of the neighbourhood variables that were discussed previously in Section 2.4 “Neighbourhood’ Influence” were tested in the progress models for English, mathematics and science. For progress in mathematics, none of the neighbourhood measures were statistically significant. However, the level of crime in the neighbourhood and the percentage of White British citizen in the neighbourhood were significant predictors of progress in English, indicating that pupils from neighbourhoods characterised by a higher level of crime or with higher percentage of White British residents made less progress in English during KS3.

Progress in science was also sensitive to neighbourhood influences. The Index of Multiple Deprivation (IMD) scores and IDACI, level of crime and perceived neighbourhood safety were all found to be significant predictors of pupils’ progress in science during secondary school. The results showed that the higher the IMD or IDACI scores indicating greater levels of neighbourhood disadvantage, the poorer the academic progress in science. Moreover, pupils from neighbourhoods characterised by a higher level of crime or as being less safe also made less progress in science.

In primary school in Year 6, the neighbourhood measures were not found to be significant for academic progress during KS2. These measures became important, however, for the academic progress in secondary school. This may be because a pupils grow older they are probably more involved in activities outside the home and with their peer group.

5.2. The Impact of Pre-, Primary and Secondary School Experience

Since multiple dimensions of the pre-, primary and secondary experiences proved to be significant predictors of pupils’ cognitive attainment in Year 9, we sought to establish whether any of the same characteristics would also be significant predictors of pupils’ academic progress between Year 6

and Year 9. Results showed that the pre-school and primary school experiences were no longer associated with the amount of academic progress pupils made during secondary school, although they still have been shown to still shape attainment in Year 9. On the other hand, the academic effectiveness of the secondary school was significant only for English and the two Ofsted measures of secondary school quality were significant predictors of pupils' progress in English, mathematics and science in KS3.

5.2.1. The Impact of Secondary School Academic Effectiveness

The secondary school academic effectiveness measured by the school level CVA was a significant predictor of progress in English (see Table 5.8). Pupils from highly (for the original data) or medium (for the imputed data) effective secondary schools made significantly more progress in English than pupils from low effective secondary schools[29].

Table 5.8: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Secondary School Academic Effectiveness (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2341**				**2996**			
Number of schools	**518**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Secondary School Academic Effectiveness (compared to low effectiveness)								
Medium effectiveness	0.09	0.05	0.14		0.11	0.06	0.17	*
High effectiveness	0.17	0.07	0.27	*	0.12	0.08	0.18	
Missing	-0.35	0.38	-0.56		-0.05	0.07	-0.08	
% Reduction school variance	89%				84%			
% Reduction pupil variance	56%				48%			
% Reduction total variance	64%				57%			

* p <0.05

5.2.2. The Impact of Secondary School Quality

In addition to the CVA indicators, Ofsted inspection data provided further measures of school quality. Secondary schools' quality measured by Ofsted inspection judgments was found to be predictor of academic progress in secondary school. The same measurements of secondary school quality which were statistically significant predictors of academic attainment proved to be important for academic progress as well in KS3. *The quality of pupils' learning and their progress* and *the attendance of learners* were positive predictors of academic progress in English, mathematics and science.

The Impact of the Quality of Pupils' Learning on Academic Progress in Secondary School

EPPSE pupils attending secondary schools classified as outstanding in terms of inspection judgments of the quality of pupils' learning made significantly greater progress in English (ES_{Orig}=0.36; $ES_{Imputed}$=0.34), mathematics (ES_{Orig}=0.32; $ES_{Imputed}$=0.40) and science TA levels (ES_{Orig}=0.29; $ES_{Imputed}$=0.35) than pupils from secondary schools characterised as inadequate in their learning quality.

Moreover, their progress in mathematics was significantly greater for those attending secondary schools characterised as good or satisfactory on learning quality than the progress of the pupils

[29] Because CVA scores were not available for all secondary schools, the measure was divided into groups – high, medium, low and missing to avoid reducing the sample size. It was deemed inappropriate to impute missing school CVA measures in this data set.

from inadequate secondary schools (see Table 5.10). The size of effects was moderately strong and showed a clear trend.

Table 5.9: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2341**				**2996**			
Number of schools	**518**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Quality of Pupils' Learning (compared to inadequate)								
Outstanding	0.23	0.09	0.36	*	0.23	0.09	0.34	*
Good	0.07	0.07	0.11		0.08	0.08	0.12	
Satisfactory	0.07	0.07	0.11		0.06	0.07	0.09	
Missing	0.08	0.10	0.13		-0.08	0.08	-0.12	
% Reduction school variance	89%				84%			
% Reduction pupil variance	56%				48%			
% Reduction total variance	64%				57%			

* p <0.05

Table 5.10: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2384**				**2996**			
Number of schools	**522**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Quality of Pupils' Learning (compared to inadequate)								
Outstanding	0.22	0.10	0.32	*	0.30	0.10	0.40	*
Good	0.24	0.08	0.35	*	0.28	0.08	0.37	*
Satisfactory	0.18	0.07	0.26	*	0.20	0.08	0.27	*
Missing	0.36	0.11	0.53	*	0.15	0.09	0.20	
% Reduction school variance	90%				88%			
% Reduction pupil variance	70%				64%			
% Reduction total variance	74%				69%			

* p <0.05

Table 5.11: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2350**				**2996**			
Number of schools	**520**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Quality of Pupils' Learning (compared to inadequate)								
Outstanding	0.20	0.09	0.29	*	0.27	0.10	0.35	*
Good	0.14	0.07	0.19		0.18	0.08	0.23	*
Satisfactory	0.02	0.07	0.03		0.05	0.07	0.07	
Missing	0.13	0.10	0.18		-0.08	0.09	-0.11	
% Reduction school variance	91%				86%			
% Reduction pupil variance	50%				43%			
% Reduction total variance	60%				53%			

* p <0.05

The Impact of the Learners' Attendance on Academic Progress in Secondary School

Academic progress in secondary school was also significantly related to the Ofsted judgment of learners' attendance. Pupils attending secondary schools rated as outstanding on the learners'

attendance had greater gains in English (ES_{Orig}=0.48; $ES_{Imputed}$=0.46) and mathematics TA levels (ES_{Orig}=0.35; $ES_{Imputed}$=0.41) than pupils from secondary schools characterised as inadequate in their overall attendance (see Table 5.12 and Table 5.13).

Additionally, pupils from secondary schools characterised as good or satisfactory on attendance made significantly greater progress in English and mathematics TA levels across KS3. The progress in science was significantly different only for pupils from secondary schools judged as good on attendance when compared to those attending inadequate secondary schools.

Table 5.12: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2341**				**2996**			
Number of schools	**518**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Attendance of Learners (compared to inadequate)								
Outstanding	0.30	0.09	0.48	*	0.31	0.10	0.46	*
Good	0.24	0.08	0.39	*	0.25	0.09	0.37	*
Satisfactory	0.25	0.08	0.40	*	0.25	0.09	0.37	*
Missing	0.27	0.10	0.43	*	0.09	0.09	0.13	
% Reduction school variance	89%				85%			
% Reduction pupil variance	56%				48%			
% Reduction total variance	64%				57%			

* p <0.05

Table 5.13: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2384**				**2996**			
Number of schools	**522**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Attendance of Learners (compared to inadequate)								
Outstanding	0.24	0.10	0.35	*	0.31	0.12	0.41	*
Good	0.29	0.09	0.43	*	0.34	0.10	0.45	*
Satisfactory	0.19	0.08	0.28	*	0.23	0.10	0.31	*
Missing	0.42	0.11	0.60	*	0.20	0.12	0.27	
% Reduction school variance	90%				88%			
% Reduction pupil variance	70%				64%			
% Reduction total variance	74%				69%			

* p <0.05

Table 5.14: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Ofsted Judgments (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2350**				**2996**			
Number of schools	**520**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Ofsted Judgment- The Attendance of Learners (compared to inadequate)								
Outstanding	0.15	0.10	0.21		0.20	0.11	0.27	
Good	0.17	0.09	0.24	*	0.22	0.10	0.29	*
Satisfactory	0.08	0.08	0.12		0.13	0.09	0.17	
Missing	0.17	0.11	0.24		-0.03	0.10	-0.04	
% Reduction school variance	91%				86%			
% Reduction pupil variance	50%				43%			
% Reduction total variance	60%				53%			

* p <0.05

In summary, the results in this section highlight the relevance of the overall academic quality of the individual secondary school a pupil attends in promoting better cognitive progress during KS3 as well as predicting better levels of attainment (as demonstrated in Section 3.3.2).

In England, national DfE and Ofsted data sets provide overall indicators of school quality and these results indicate that pupils who attended a better secondary school (as measured by CVA scores and Ofsted judgments) benefited in terms of both their level of attainment in Year 9 and in making more progress across KS3.

5.3. Exploring the Effects of School and Teaching Processes on Academic Progress during KS3

The following factors that were tested as separate predictors of the Year 9 cognitive attainment were also tested in order to establish their significance in predicting pupils' academic progress during KS3 (see Section 4.1):

- Emphasis on learning
- Behaviour climate
- Headteacher
- School environment
- Valuing pupils
- School/Learning resources
- Teacher behavioural management
- Teacher support

For progress in each core curriculum subject, a number of the school factors were found to be statistically significant predictors of progress across KS3. Originally, the items that entered in the composition of any of the factors were Likert type scale that went from (1) strongly agree to (4) strongly disagree. These were reversed in order to make the interpretation easier. The factors were treated as continuous measures and were centred to the grand mean. Only the factors that were statistically significant predictors of academic progress are presented.

The academic progress in English was significantly predicted by 'emphasis on learning', 'behaviour climate', 'valuing pupils' and 'teacher support', although the effects sizes were weak and found to be significant mostly for the original sample (between 0.14 and 0.17 for the original sample or between 0.08 and 0.15 for the imputed sample). Pupils from secondary schools where they perceived a stronger emphasis on learning, a positive behaviour climate and teachers valuing the pupils and providing support to their pupils made significantly more progress in English during KS3. Interestingly, 'Valuing pupils and 'Teacher support' were not statistically significant predictors of English TA levels; however, they were important and significant factors in predicting academic progress in English.

Table 5.15: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Emphasis on Learning (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE[30]			
Number of pupils	**1396**				**2632**			
Number of schools	**380**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.26	0.11	0.14	*	0.26	0.13	0.13	
% Reduction school variance	91%				90%			
% Reduction pupil variance	60%				52%			
% Reduction total variance	67%				62%			

* p <0.05

Table 5.16: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**1396**				**2632**			
Number of schools	**380**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Behaviour Climate (continuous)	0.13	0.05	0.15	*	0.14	0.06	0.15	*
% Reduction school variance	91%				90%			
% Reduction pupil variance	60%				52%			
% Reduction total variance	67%				62%			

* p <0.05

Table 5.17: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Valuing Pupils (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**1397**				**2632**			
Number of schools	**380**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Valuing Pupils (continuous)	0.15	0.06	0.14	*	0.10	0.06	0.08	
% Reduction school variance	91%				90%			
% Reduction pupil variance	60%				52%			
% Reduction total variance	67%				61%			

* p <0.05

Table 5.18: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Teacher Support (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**1375**				**2632**			
Number of schools	**377**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Teacher Support (continuous)	0.17	0.06	0.17	*	0.11	0.05	0.10	*
% Reduction school variance	91%				90%			
% Reduction pupil variance	60%				52%			
% Reduction total variance	67%				62%			

* p <0.05

[30] These analyses are based on a further imputation model that incorporated additional measures of pupils' self-perceptions.

For the academic progress in mathematics during KS3, the following factors were found to be statistically significant: 'emphasis on learning', 'behaviour climate', 'headteacher', 'school environment', 'valuing pupils', 'school/learning resources' and 'Teacher support' (see Table 5.19-Table 5.25). The ES ranged between 0.12 and 0.35 and most of them were statistically significant only for the original sample. Pupils from schools that were rated more positively for their emphasis on learning, provide a positive school behaviour climate, a pleasant environment and good learning resources made more academic progress in mathematics than pupils from schools that were weaker in these dimensions. The factor measuring pupils' views of the leadership qualities of the headteacher was also found to be statistically significant predictor for academic progress in mathematics, which is an interesting finding as the same qualities did not predict cognitive attainment in mathematics. Pupils who perceived their headteacher as interested in what they learn and actively involved in the educational processes made more progress during KS3 than pupils who did not perceived their headteacher having these qualities. Similarly, the factor measuring pupils' views of teachers' supportive approach significantly predicted progress, although it had not been found to be a significant predictor of differences in attainment.

Table 5.19: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Emphasis on Learning (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1416				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.38	0.11	0.19	*	0.29	0.12	0.13	*
% Reduction school variance	94%				90%			
% Reduction pupil variance	73%				67%			
% Reduction total variance	77%				72%			

* p <0.05

Table 5.20: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1416				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Behaviour Climate (continuous)	0.32	0.06	0.35	*	0.32	0.06	0.32	*
% Reduction school variance	94%				90%			
% Reduction pupil variance	74%				67%			
% Reduction total variance	77%				72%			

* p <0.05

Table 5.21: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Headteacher (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1415				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Headteacher (continuous)	0.12	0.05	0.15	*	0.05	0.05	0.05	
% Reduction school variance	95%				90%			
% Reduction pupil variance	73%				67%			
% Reduction total variance	77%				72%			

* p <0.05

Table 5.22: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: School Environment (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1417				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
School Environment (continuous)	0.16	0.08	0.12	*	0.07	0.09	0.05	
% Reduction school variance	94%				90%			
% Reduction pupil variance	73%				67%			
% Reduction total variance	77%				72%			

* p <0.05

Table 5.23: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Valuing Pupils (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1417				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Valuing Pupils (continuous)	0.25	0.07	0.21	*	0.17	0.07	0.12	*
% Reduction school variance	94%				90%			
% Reduction pupil variance	73%				67%			
% Reduction total variance	77%				72%			

* p <0.05

Table 5.24: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Learning Resources (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1417				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Learning Resources (continuous)	0.38	0.13	0.17	*	0.21	0.15	0.9	
% Reduction school variance	94%				90%			
% Reduction pupil variance	73%				67%			
% Reduction total variance	77%				72%			

* p <0.05

Table 5.25: Contextualised Value Added Models for Mathematics Teacher Assessment Levels in Year 9: Teacher Support (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	1395				2632			
Number of schools	379				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Teacher Support (continuous)	0.19	0.06	0.18	*	0.09	0.07	0.07	
% Reduction school variance	94%				90%			
% Reduction pupil variance	73%				67%			
% Reduction total variance	77%				72%			

* p <0.05

Pupils' academic progress in science was significantly predicted by 'emphasis on learning', 'behaviour climate', 'school environment', 'valuing pupils' , 'learning resources', 'teacher discipline' and 'teacher support'. The ES were modest and statistically significant mostly for the original sample (between 0.14 and 0.21 for the original sample or between 0.04 and 0.10 for the imputed sample).

Pupils, who perceived that their secondary school placed a stronger emphasis on learning, provided a positive behaviour climate, a pleasant physical environment and good learning resources made significantly more progress in science during KS3. Moreover, pupils who perceived that their teachers value and support them also made significantly more progress in science. The factor related to 'teacher Behavioural Management' was also identified as a significant predictor of academic progress in science during KS3.This school factor was not significant in predicting Year 9 cognitive attainment in any of the subjects. These results suggest that while teachers' behaviours are not always statistically significantly associated with attainment, they may be more important in predicting academic progress.

Table 5.26: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Emphasis on Learning (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**1403**				**2632**			
Number of schools	**382**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Emphasis on Learning (continuous)	0.32	0.12	0.16	*	0.17	0.12	0.08	
% Reduction school variance	89%				91%			
% Reduction pupil variance	55%				47%			
% Reduction total variance	63%				57%			

* p <0.05

Table 5.27: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Behaviour Climate (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**1403**				**2632**			
Number of schools	**382**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Behaviour Climate (continuous)	0.19	0.06	0.21	*	0.23	0.07	0.10	*
% Reduction school variance	90%				90%			
% Reduction pupil variance	55%				47%			
% Reduction total variance	63%				57%			

* p <0.05

Table 5.28: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: School Environment (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**1404**				**2632**			
Number of schools	**382**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
School Environment (continuous)	0.20	0.08	0.15	*	0.08	0.09	0.06	
% Reduction school variance	89%				90%			
% Reduction pupil variance	55%				47%			
% Reduction total variance	63%				57%			

* p <0.05

Table 5.29: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Valuing Pupils (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1404				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Valuing Pupils (continuous)	0.26	0.07	0.21	*	0.13	0.07	0.10	
% Reduction school variance	89%				90%			
% Reduction pupil variance	55%				47%			
% Reduction total variance	63%				57%			

* p <0.05

Table 5.30: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Learning Resources (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1404				2632			
Number of schools	382				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Learning Resources (continuous)	0.42	0.13	0.19	*	0.23	0.13	0.09	
% Reduction school variance	89%				90%			
% Reduction pupil variance	55%				47%			
% Reduction total variance	63%				57%			

* p <0.05

Table 5.31: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Teacher Behavioural Management (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1380				2632			
Number of schools	378				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Teacher Behavioural Management ((continuous)	0.28	0.11	0.14	*	0.12	0.12	0.05	
% Reduction school variance	91%				90%			
% Reduction pupil variance	54%				47%			
% Reduction total variance	63%				57%			

* p <0.05

Table 5.32: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Teacher Support (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	1382				2632			
Number of schools	379				567			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Teacher Support (continuous)	0.18	0.06	0.17	*	0.05	0.08	0.04	
% Reduction school variance	89%				90%			
% Reduction pupil variance	56%				47%			
% Reduction total variance	64%				57%			

* p <0.05

5.3.1. Time Spent on Homework

As shown in section 4.2, pupils' self-reports of time spent on homework was positively linked to higher TA levels for all three subjects. Similarly, time spent on homework was a significant predictor of academic progress in the core subjects. For English and science, the relationship between time spent on homework and academic progress followed an incremental gradation up to 2-3 hours. Spending more than 3 hours on homework did not offer extra benefits for progress in English and science. The highest benefit of studying for 2-3 hours was found for mathematics (ES_{Orig}=0.84; $ES_{Imputed}$=0.59), followed by English (ES_{Orig}=0.76; $ES_{Imputed}$=0.60) and finally for science (ES_{Orig}=0.69; $ES_{Imputed}$=0.47). Studying for more than 3 hours significantly predicted better progress in English and mathematics, but only for the original data.

Table 5.33: Contextualised Value Added Models for English Teacher Assessment Levels in Year 9: Time Spent on Homework (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2341**				**2632**			
Number of schools	**518**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Time Spent on Homework (compared to none)								
Less than ½ hour	0.24	0.09	0.39	*	0.16	0.08	0.25	*
½-1 hour	0.23	0.08	0.36	*	0.19	0.07	0.29	*
1-2 hours	0.26	0.09	0.42	*	0.23	0.08	0.35	*
2-3 hours	0.48	0.11	0.76	*	0.39	0.11	0.60	*
Over 3 hours	0.46	0.21	0.74	*	0.32	0.19	0.50	
Missing	0.09	0.08	0.15					
% Reduction school variance	89%				90%			
% Reduction pupil variance	56%				52%			
% Reduction total variance	64%				62%			

* p <0.05

Table 5.34: Contextualised Value Added Model for Mathematics Teacher Assessment Levels in Year 9: Time Spent on Homework (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2384**				**2632**			
Number of schools	**522**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Time Spent on Homework (compared to none)								
Less than ½ hour	0.21	0.09	0.31	*	0.12	0.09	0.17	
½-1 hour	0.30	0.09	0.44	*	0.23	0.10	0.32	*
1-2 hours	0.36	0.09	0.53	*	0.29	0.10	0.41	*
2-3 hours	0.58	0.12	0.84	*	0.42	0.14	0.59	*
Over 3 hours	0.70	0.23	1.03	*	0.53	0.26	0.74	
Missing	0.15	0.09	0.21					
% Reduction school variance	88%				90%			
% Reduction pupil variance	71%				67%			
% Reduction total variance	74%				72%			

* p <0.05

Table 5.35: Contextualised Value Added Models for Science Teacher Assessment Levels in Year 9: Time Spent on Homework (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2350**				**2632**			
Number of schools	**520**				**567**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Time Spent on Homework (compared to none) Less than ½ hour	0.17	0.10	0.24		0.10	0.10	0.14	
½-1 hour	0.21	0.09	0.30	*	0.15	0.10	0.21	
1-2 hours	0.28	0.09	0.39	*	0.21	0.12	0.29	
2-3 hours	0.49	0.13	0.69	*	0.34	0.13	0.47	*
Over 3 hours	0.29	0.24	0.42		0.25	0.26	0.34	
Missing	0.06	0.09	0.09					
% Reduction school variance	92%				91%			
% Reduction pupil variance	50%				47%			
% Reduction total variance	60%				57%			

* p <0.05

6. Does the Primary to Secondary Transition Affect KS3 Outcomes?

In a previous report (Evangelou et al., 2008) the transition from primary to secondary school was studied for a subsample of the EPPSE pupils. The demographical characteristics of this subsample are presented in Table 6.1 and Table 6.2.

Table 6.1: Selected Characteristics of Pupils in Year 6 and Year 9 - Original and Transition Sample

	Year 9 Original Sample N=3002		Year 6 Transition Sample N=550	
	N	%	N	%
Gender				
Male	1543	51.4	251	45.6
Female	1459	48.6	299	54.4
Ethnicity				
White UK Heritage	2206	73.5	421	76.5
White European Heritage	110	3.7	16	2.9
Black Caribbean Heritage	109	3.6	20	3.6
Black African Heritage	61	2.0	6	1.1
Indian Heritage	64	2.1	14	2.5
Pakistani Heritage	160	5.3	21	3.8
Bangladeshi Heritage	31	1.0	8	1.5
Mixed Heritage	181	6.0	29	5.3
Any Other Ethnic Minority Heritage	78	2.6	14	2.5
Missing	*2*	*0.1*	*1*	*.2*
Number of Siblings in the House at First Parent Interview				
No siblings	600	20.0	115	20.9
1 - 2 siblings	1896	63.2	360	65.4
3+ siblings	466	15.5	69	12.5
Missing	*40*	*1.3*	*6*	*1.1*
Early Years Home Learning Environment (HLE) Index				
<13	283	9.4	51	9.3
14-19	645	21.5	111	20.2
20-24	706	23.5	116	21.1
25-32	934	31.1	185	33.6
>33	338	11.3	70	12.7
Missing	*96*	*3.2*	*17*	*3.1*
Type of Pre-School				
Nursery class	580	19.3	29	5.3
Playgroup	587	19.6	126	22.9
Private day nursery	488	16.3	94	17.1
Local Authority day nursery	401	13.4	66	12.0
Nursery schools	495	16.5	172	31.3
Integrated (Combined) centres	170	5.7	29	5.3
Home	281	9.4	34	6.2

Table 6.2: Selected Characteristics of Pupils in Year 6 and Year 9- Original and Transition Sample

	Year 9 Original Sample N=3002		Year 6 Transition Sample N=550	
	N	**%**	**N**	**%**
Mother's Qualifications				
None	626	20.9	83	15.1
Vocational	434	14.5	85	15.5
16 Academic	1093	36.4	244	44.4
18 Academic	242	8.1	47	8.5
Degree or Higher degree	484	16.1	76	13.8
Other professional	44	1.5	7	1.3
Missing	*79*	*2.6*	*8*	*1.5*
Father's Qualifications				
None	477	15.9	78	14.2
Vocational	337	11.2	74	13.5
16 academic	668	22.3	142	25.8
18 academic	215	7.2	41	7.5
Degree or Higher degree	508	16.9	90	16.4
Other professional	32	1.1	8	1.5
Absent Father	724	24.1	112	20.4
Missing	*41*	*1.4*	*5*	*.9*
Family Highest SES at First Parent Interview				
Professional Non Manual	264	8.8	40	7.3
Other Professional Non manual	749	25.0	146	26.5
Skilled Non Manual	953	31.7	184	33.5
Skilled Manual	442	14.7	72	13.1
Semi-Skilled	390	13.0	77	14.0
Unskilled	74	2.5	16	2.9
Unemployed / Not working	84	2.8	9	1.6
Missing	*46*	*1.5*	*6*	*1.1*
FSM at Year 9				
No Free School Meals (FSM) (at Year 9)	2267	75.5	453	82.4
Free School Meals (FSM) (at Year 9)	534	17.8	83	15.1
Missing	*201*	*6.7*	*14*	*2.5*
Family Earned Income at KS1				
No salary	565	18.8	99	18.0
£ 2,500 – 17,499	480	16.0	93	16.9
£ 17,500 – 29,999	410	13.7	106	19.3
£ 30,000 – 37,499	271	9.0	62	11.3
£ 37,500 – 67,499	468	15.6	103	18.7
£ 67,500 – 132,000+	170	5.7	25	4.5
Missing	*638*	*21.3*	*62*	*11.3*
SEN STATUS AT YEAR 9				
No Special Provision	2161	72.0	444	80.7
School Action	321	10.7	52	9.5
School Action Plus	187	6.2	26	4.7
Statement of SEN	97	3.2	15	2.7
Missing	*236*	*7.9*	*13*	*2.4*

In the report, the primary to secondary transition was considered in terms of five dimensions that emerge from questionnaire responses (see Table 6.3). These dimensions appeared to summarise the most important aspects of the transition as perceived by students and parents. These five dimensions were:

1. Developing friendships, self-esteem and confidence
2. Settling into school life
3. Showing interest in school and work
4. Getting used to new routines
5. Experiencing curriculum continuity

Underlying dimensions of a successful transition	
	Loadings
Developing friendships and confidence (1=less, 2=same, 3=more)	
1. Compared with Y6, child's school friends (source: parents)	0.403
2. Compared with Y6, child's self-esteem (source: parents)	0.868
3. Compared with Y6, child's confidence (source: parents)	0.881
4. Compared with Y6, child's motivation (source: parents)	0.564
Cronbach's alpha= 0.839; Median= 2.5, SD= 0.52, N= 506	
1-2.5 = "0" (n = 266) versus 2.75-3 = "1" (n = 240)	
Settling in school life (1=not at all to 4= very well/much)	
1. Child settling in (source: parents)	0.643
2. Satisfaction with the process of transition (source: parents)	0.475
3. Not having felt concerned about child when first moved on (source: parents)	0.471
4. Not feeling concerned about child now (source: parents)	0.774
5. Child settling in (source: children)	0.365
Cronbach's alpha= 0.747; Median= 3.6, SD= 0.49, N= 485	
1.2-3.4 = "0" (n= 239) versus 3.6-4 = "1" (n = 246)	
Showing a growing interest in school and work (1=less, 2=same, 3=more)	
1. Compared with Y6, child's interest in school (source: parents)	0.797
2. Compared with Y6, child's interest in school work (source: parents)	0.772
Cronbach's alpha= 0.824; Median= 2.5, SD=0.56, N= 504	
1-2.5 = "0" (n = 295) versus 3 = "1" (n = 209)	
Getting used to new routines (1=very difficult to 4= very easy)	
1. Having many different teachers (source: children)	0.740
2. Changing classrooms between lessons (source: children)	0.665
3. Behaviour and discipline (source: children)	0.472
4. Not being with same pupils in all lessons (source: children)	0.507
Cronbach's alpha= 0.700; Median= 3.00, SD= 0.54, N= 490	
1-3="0" (n = 271) versus 3.25-4 = "1" (n = 219)	
Experiencing curriculum continuity (1=not at all to 4 = very)	
1. English in Y6 helped cope with Y7 work (source: children)	0.762
2. Maths in Y6 helped cope with Y7 work (source: children)	0.580
3. Sciences in Y6 helped cope with Y7 work (source: children)	0.663
Cronbach's alpha= 0.702; Median= 3.00, SD= 0.59, N=516	
1-3="0" (n = 276) versus 3.3-4 = "1" (n= 240)	

Table 6.3: Underlying Dimensions of a Successful Transition Using Factor Analysis (N=550 children)

In order to establish if there was a relationship between the primary to secondary school transition and KS3 outcomes, these dimensions were tested for their effects in multilevel models. Each dimension was considered individually in order to see which aspects of the transition had effects on KS3 outcomes.

Two sets of multilevel analyses were conducted. In the first set of multilevel models, a KS3 outcome was analysed for the effects of a transition dimension, controlling for all child, family, home, area and HLE characteristics. The main contextualised models predicting KS3 TA levels and identified with the original sample (N=3002) were extended to test the significant predictors on this subsample (N=550) (see Appendix for the complete models). In the second set of multilevel models, variables reflecting primary school and secondary school effectiveness were also included as predictors. This second set of analyses test whether transition dimensions influence KS3 outcomes independently of primary or secondary school characteristics.

The results of both sets of analyses were extremely similar, indicating that the transition dimension effects were largely independent of primary or secondary school effectiveness. The results that include control for primary and secondary school effectiveness are summarised here. Table 6.4

shows the results for the transition dimension “Getting used to new routines”, and Table 6.5 shows the results for the transition dimension “Experiencing curriculum continuity”. In both cases all three KS3 academic outcomes are dealt with.

Table 6.4: Contextualised Models for Year 9 Cognitive Attainment: Getting Used to New Routines

	Year 9 English TA				Year 9 Mathematics TA				Year 9 Science TA			
Number of pupils	**461**				**467**				**461**			
Number of schools	**221**				**224**				**221**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Getting used to new routines (continuous)	0.17	0.08	0.23	*	0.34	0.11	0.32	*	0.24	0.09	0.29	*
Log restricted-likelihood	-602.83				-738.87				-642.13			
Random Effects												
School variance	0.08				0.09				0.05			
Residual variance	0.65				1.28				0.84			
Intra-school correlation (ICC)	0.1090				0.0667				0.0593			
Null model												
School variance	0.06				0.19				0.18			
Residual variance	0.94				1.59				0.98			
Intra-school correlation (ICC)	0.0585				0.1081				0.1522			
% Reduction school variance	-36%				53%				70%			
% Reduction pupil variance	31%				20%				15%			
% Reduction total variance	27%				23%				23%			

* p <0.05

Table 6.5: Contextualised Models for Year 9 Cognitive Attainment: Experiencing Curriculum Continuity

	Year 9 English TA				Year 9 Mathematics TA				Year 9 Science TA			
Number of pupils	**486**				**491**				**485**			
Number of schools	**234**				**237**				**233**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Experiencing curriculum continuity (continuous)	0.18	0.07	0.26	*	0.28	0.10	0.28	*	0.15	0.08	0.21	*
Log restricted-likelihood	-644.88				-790.53				-663.14			
Random Effects												
School variance	0.09				0.08				0.09			
Residual variance	0.67				1.37				0.75			
Intra-school correlation (ICC)	0.1146				0.0582				0.1046			
Null model												
School variance	0.06				0.19				0.18			
Residual variance	0.94				1.59				0.98			
Intra-school correlation (ICC)	0.0585				0.1081				0.1522			
% Reduction school variance	-49%				56%				50%			
% Reduction pupil variance	29%				16%				23%			
% Reduction total variance	24%				19%				27%			

* p <0.05

The results show that the transition dimensions, getting used to new routines, and experiencing curriculum continuity, both have significant effects on all three KS3 outcomes of English, mathematics and science. The effect sizes are all in the range 0.21 to 0.32, with the strongest effects for KS3 mathematics.

One other transition dimension, settling into school life, had a significant effect on KS3 mathematics only. However, this effect became non-significant when primary and secondary school effectiveness were controlled, indicating that this was not an independent transition effect. The remaining transition dimensions, “Developing friendships, self-esteem and confidence” and “Showing interest in school and work” appeared to be unrelated to KS3 academic outcomes.

Regarding academic progress, 'getting used to new routines' was a statistically significant positive predictor of academic progress in science during KS3 (see Table 6.6), while 'experiencing curriculum continuity' was a statistically significant positive predictor of academic progress in mathematics (see Table 6.7).

Table 6.6: Contextualised Value Added Models for Academic Progress in Science: Getting Used to New Routines (individual pupil, family and HLE characteristics and prior attainment)

	Year 9 Science TA			
Number of pupils	**436**			
Number of schools	**211**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**
Getting used to new routines (continuous)	0.16	0.07	0.24	*
Log restricted-likelihood	-504.85			
Random Effects				
School variance	0.03			
Residual variance	0.48			
Intra-school correlation (ICC)	0.0661			
Null model				
School variance	0.18			
Residual variance	0.98			
Intra-school correlation (ICC)	0.1522			
% Reduction school variance	81%			
% Reduction pupil variance	51%			
% Reduction total variance	55%			

* p <0.05

Table 6.7: Contextualised Value Added Models for Academic Progress in Mathematics: Experiencing Curriculum Continuity (individual pupil, family and HLE characteristics and prior attainment)

	Year 9 Mathematics TA			
Number of pupils	**464**			
Number of schools	**226**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**
Experiencing curriculum continuity (continuous)	0.14	0.06	0.27	*
Log restricted-likelihood	-498.22			
Random Effects				
School variance	0.07			
Residual variance	0.36			
Intra-school correlation (ICC)	0.1667			
Null model				
School variance	0.19			
Residual variance	1.59			
Intra-school correlation (ICC)	0.1081			
% Reduction school variance	62%			
% Reduction pupil variance	77%			
% Reduction total variance	76%			

* p <0.05

In summary it appears that having a successful primary to secondary school transition can improve KS3 outcomes 3 years later and academic progress. In particular the aspects of the transition included in the dimensions, Getting used to new routines, and Experiencing curriculum continuity, seem to be most important.

7. The Impact of Primary School Mobility During KS1 and KS2

The present analyses explored the relationships between mobility during KS1 and KS2 in primary school and pupils' later cognitive outcomes in KS3. The results are presented only on the original data set. It should be noted that no measures are available for pupils' mobility in secondary school across KS3.

We adopted the definition of pupil mobility used in previous reports when the EPPSE sample was in primary school. In this definition, mobility referred to a change of primary school that did not result from a school closure, amalgamation, or transfer across phases of schooling. For the original sample (n=3002), we combined the two measures of mobility for a change of primary school between KS1, KS2 and mobility in terms of a change of primary school between KS1 and KS2. More than 11% of the pupils had moved primary school only in KS1, while almost 16% moved only in KS2. In total nearly 4% of pupils had moved primary schools in both KS1 and KS2 (see Table 7.1).

Table 7.1: Mobility During KS1 and KS2

	n	%
Missing	34	1.1
No mobility at all	1887	62.9
Mobility only in KS1	340	11.3
Mobility only in KS2	474	15.8
Mobility in both	109	3.6
Moved between KS1 and KS2	158	5.3
Total	3002	100

Previous analyses showed that moving primary schools in either KS1 or KS2 was related to the level of social (dis)advantage; pupils from disadvantaged families being more likely to move primary schools (Melhuish et al., 2008b).

Table 7.2 and Table 7.3 present the cross-tabulations between mobility and multiple disadvantage[31] at various time points. Pupils who had a more disadvantaged background were more likely to move primary schools during KS1 and KS2. However, the associations between mobility and multiple disadvantage were not statistically significant.

Table 7.2: Mobility During KS1 and Multiple Disadvantage Index

Multiple disadvantage	Mobility during KS1					
	Non-mobile		Mobile		Total	
	n	n	n	n	n	n
0 (no disadvantage)	543	86.5%	85	13.5%	628	100.0%
1	647	86.3%	103	13.7%	750	100.0%
2	492	84.1%	93	15.9%	585	100.0%
3	306	82.0%	67	18.0%	373	100.0%
4	207	86.3%	33	13.8%	240	100.0%
5 plus (high disadvantage)	159	82.4%	34	17.6%	193	100.0%

[31] The Multiple Disadvantage index is a single measure combining ten different variables (from the child, parent, and home level, each of which has been shown to be an indicator of 'risk' of poor educational outcomes (Sammons et al., 2004d).

Multiple disadvantage	Mobility during KS1					
	Non-mobile		Mobile		Total	
	n	n	n	n	n	n
0 (no disadvantage)	543	86.5%	85	13.5%	628	100.0%
1	647	86.3%	103	13.7%	750	100.0%
2	492	84.1%	93	15.9%	585	100.0%
3	306	82.0%	67	18.0%	373	100.0%
4	207	86.3%	33	13.8%	240	100.0%
5 plus (high disadvantage)	159	82.4%	34	17.6%	193	100.0%
Total	2354	85.0%	415	15.0%	2769	100.0%

Table 7.3: Mobility During KS1 and Multiple Disadvantage Index

Multiple Disadvantage	Mobility during KS2					
	Non-mobile		Mobile		Total	
	n	%	n	%	n	%
0 (no disadvantage)	508	82.6%	107	17.4%	615	100.0%
1	586	79.9%	147	20.1%	733	100.0%
2	462	80.5%	112	19.5%	574	100.0%
3	277	76.7%	84	23.3%	361	100.0%
4	175	78.1%	49	21.9%	224	100.0%
5 plus (high disadvantage)	147	77.8%	42	22.2%	189	100.0%
Total	2155	79.9%	541	20.1%	2696	100.0%

When exploring the relationship between KS1-KS2 mobility and cognitive outcomes in KS3, we found that mobility during KS2 was a negative predictor of Year 9 TA levels in English, mathematics and science (see Table 7.4, Table 7.5, Table 7.6). Pupils who had changed primary school only during KS2 obtained lower levels of Year 9 TA in all three core areas of the curriculum English, mathematics and science, even when the analyses controlled for the influence of a range of pupil and family background characteristics, HLE, neighbourhood disadvantage and school level FSM. Additionally, for mathematics, mobility during KS1 was also found to be a negative predictor of lower levels of TA in Year 9. Pupils who had moved primary schools during KS1 obtained significantly lower levels of TA in mathematics in Year 9 than pupils who had not moved at all.

In interpreting these results we note that the ES are relatively modest (in the order of ES 0.18 for mathematics, ES 0.14 for English and ES 0.15 for science for mobility in KS2 versus no change of primary school).

It is possible that a disruption to educational experiences occasioned by a change of primary school unsettles pupils and affects their attainment. Alternatively, it may be that the change of schools is related to an unsettling life event (e.g., parental divorce, re-partnering/marriage, change of occupation/unemployment) or some combination of the two. It may also be the case that some changes of school are linked to or reflect difficulties a child has in their primary schooling (e.g., a response to bullying, lack of friends or parents' concerns over educational standards). We thus cannot attribute causality to the relationship we have identified but rather can conclude that mobility during the primary school period tends to predict poorer academic outcomes in secondary school and thus can be viewed as a potential risk factor.

Table 7.4: Contextualised Models for English Teacher Assessment Levels in Year 9 (Original Data): Primary School Mobility

	Year 9 English TA Original Data			
Number of pupils	**2457**			
Number of schools	**531**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.01	0.19	*
Gender (compared to boys)	0.38	0.04	0.46	*
Birth weight (compared to normal)				
Very Low Weight	-0.29	0.14	-0.36	*
Low Birth Weight	0.01	0.07	0.01	
Missing	0.11	0.15	0.14	
Ethnic groups (compared to White UK Heritage)				
White European	-0.05	0.10	-0.06	
Black Caribbean	0.02	0.10	0.03	
Black African	0.03	0.13	0.03	
Other Ethnic Minority	0.04	0.12	0.05	
Indian	0.15	0.13	0.18	
Pakistani	0.07	0.11	0.09	
Bangladeshi	0.26	0.19	0.32	
Mixed Heritage	-0.05	0.08	-0.07	
Early Developmental Problems (compared to none)				
1+ Developmental Problem	-0.17	0.05	-0.21	*
Missing	0.25	0.93	0.30	
Early Behavioural Problems (compared to none)				
1 + Behavioural Problem	-0.14	0.05	-0.17	*
Number of Siblings (compared to none)				
1 sibling	0.02	0.05	0.03	
2 siblings	-0.08	0.05	-0.10	
3 or more siblings	-0.24	0.06	-0.29	*
Missing	0.29	0.35	0.36	
Mother's Age	0.08	0.03	0.14	*
FSM in Year 9 (compared to none)				
Eligible for FSM	-0.24	0.05	-0.29	*
Missing	0.03	0.18	0.03	
Family Salary (compared to 'no salary')				
2,500 – 15,000	0.02	0.06	0.03	
17,500 – 27,500	0.08	0.06	0.10	
30,000 – 37,000	0.08	0.07	0.10	
37,500– 66,000	0.15	0.07	0.19	*
+67,500	0.32	0.12	0.39	*
Missing	0.13	0.06	0.15	*
Family Socio Economic Status (compared to the Highest)				
Other professional non manual	-0.06	0.08	-0.07	
Skilled non manual	-0.10	0.09	-0.12	
Skilled manual	-0.23	0.10	-0.28	*
Semi skilled	-0.17	0.10	-0.21	
Unskilled	-0.16	0.14	-0.20	
Unemployed: not working	0.00	0.14	-0.01	
Missing	-0.24	0.31	-0.30	
Mother's Qualification (compared to none)				
Vocational	0.15	0.06	0.18	*
Academic age 16	0.18	0.05	0.22	*
Academic age 18	0.29	0.08	0.35	*
Degree or Higher Degree	0.51	0.08	0.62	*
Other professional / Miscellaneous	0.40	0.15	0.49	*
Missing	0.13	0.17	0.16	
Father's Qualification (compared to none)				
Vocational	0.06	0.07	0.07	
Academic age 16	0.06	0.06	0.08	
Academic age 18	0.17	0.08	0.20	*

Degree or Higher Degree	0.28	0.08	0.35	*
Other professional / Miscellaneous	0.27	0.18	0.33	
Absent Father	0.00	0.06	0.00	
Missing	-0.77	0.35	-0.94	*
Early Years HLE (compared to 0 – 13)				
14 – 19	0.02	0.07	0.02	
20 – 24	0.02	0.07	0.03	
25 – 32	0.14	0.07	0.17	*
33 – 45	0.23	0.08	0.28	*
Missing	0.03	0.13	0.04	
KS1 HLE Enrichment Outings (compared to low)				
Medium KS1 HLE	0.14	0.05	0.17	*
High KS1 HLE	0.20	0.08	0.24	*
KS2 HLE Educational Computing (compared to low)				
Medium KS2 HLE	0.15	0.04	0.19	*
High KS2 HLE	0.10	0.07	0.12	
FSM school level	-0.004	0.002	-0.15	*
% White British	-0.004	0.001	-0.26	*
IMD 2004	-0.003	0.001	-0.16	*
KS1- KS2 mobility (compared to no mobility)				
KS1 mobility	-0.05	0.06	-0.06	
KS2 mobility	-0.12	0.05	-0.14	*
Both KS1 and KS2 mobility	-0.10	0.10	-0.12	
Mobility between KS1 and KS2	0.05	0.08	0.06	
Intercept	4.70	0.13		
Log restricted-likelihood	-3163.17			
Random Effects				
School variance	0.06		0.01	
Residual variance	0.67		0.02	
Intra-school correlation (ICC)	0.0813			
Null model				
School variance	0.28		0.04	
Residual variance	0.89		0.03	
Intra-school correlation (ICC)	0.2397			
% Reduction school variance	79%			
% Reduction pupil variance	25%			
% Reduction total variance	38%			

Table 7.5: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9 (Original Data): Primary School Mobility

	Year 9 Mathematics TA Original Data			
Number of pupils	**2494**			
Number of schools	**534**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.01	0.14	*
Gender (compared to boys)	-0.05	0.05	-0.04	
Birth weight (compared to normal)				
Very Low Weight	-0.44	0.20	-0.38	*
Low Birth Weight	-0.09	0.09	-0.08	
Missing	0.29	0.20	0.25	
Ethnic groups (compared to White UK Heritage)				
White European	-0.07	0.14	-0.06	
Black Caribbean	0.01	0.14	0.01	
Black African	-0.16	0.18	-0.14	
Other Ethnic Minority	0.30	0.17	0.26	
Indian	0.39	0.18	0.34	*

Pakistani	0.11	0.15	0.09	
Bangladeshi	0.44	0.26	0.39	
Mixed Heritage	-0.06	0.11	-0.06	
Early Developmental Problems (compared to none)				
1+ Developmental Problem	-0.18	0.07	-0.16	*
Missing	0.95	0.66	0.83	
Early Behavioural Problems (compared to none)				
1 + Behavioural Problem	-0.20	0.07	-0.18	*
Number of Siblings (compared to none)				
1 sibling	0.05	0.07	0.05	
2 siblings	0.00	0.07	0.00	
3 or more siblings	-0.20	0.08	-0.18	*
Missing	-0.59	0.43	-0.52	
FSM in Year 9 (compared to none)				
Eligible for FSM	-0.34	0.07	-0.29	*
Missing	-0.29	0.25	-0.25	
Family Salary (compared to 'no salary')				
2,500 – 15,000	0.007	0.08	0.006	
17,500 – 27,500	0.19	0.09	0.17	*
30,000 – 37,000	0.13	0.10	0.11	
37,500– 66,000	0.24	0.10	0.21	*
+67,500	0.18	0.16	0.16	
Missing	-0.03	0.08	-0.03	
Family Socio Economic Status (compared to the Highest)				
Other professional non manual	-0.04	0.12	-0.04	
Skilled non manual	-0.21	0.13	-0.19	
Skilled manual	-0.38	0.14	-0.33	*
Semi skilled	-0.36	0.14	-0.31	*
Unskilled	-0.40	0.20	-0.35	*
Unemployed: not working	0.19	0.20	0.17	
Missing	-0.60	0.37	-0.52	
Mother's Qualification (compared to none)				
Vocational	0.07	0.09	0.06	
Academic age 16	0.21	0.07	0.18	*
Academic age 18	0.37	0.11	0.32	*
Degree or Higher Degree	0.58	0.11	0.50	*
Other professional / Miscellaneous	0.44	0.21	0.38	*
Missing	0.13	0.20	0.11	
Father's Qualification (compared to none)				
Vocational	0.18	0.09	0.16	*
Academic age 16	0.13	0.08	0.11	
Academic age 18	0.19	0.11	0.16	
Degree or Higher Degree	0.41	0.11	0.36	*
Other professional / Miscellaneous	0.23	0.24	0.20	
Absent Father	0.03	0.08	0.03	
Missing	-0.92	0.43	-0.80	*
Early Years HLE (compared to 0 – 13)				
14 – 19	0.10	0.09	0.08	
20 – 24	0.12	0.10	0.10	
25 – 32	0.27	0.10	0.23	*
33 – 45	0.43	0.12	0.38	*
Missing	0.22	0.18	0.19	
KS2 HLE Educational Computing (compared to low)				
Medium KS2 HLE	0.19	0.05	0.16	*
High KS2 HLE	0.14	0.09	0.12	
FSM school level	-0.01	0.00	-0.20	*
% White British	-0.005	0.002	-0.20	*
IMD 2004	-0.002	0.002	-0.07	
KS1- KS2 mobility (compared to no mobility)				
KS1 mobility	-0.16	0.08	-0.14	*
KS2 mobility	-0.20	0.07	-0.18	*
Both KS1 and KS2 mobility	-0.14	0.14	-0.12	

Mobility between KS1 and KS2	-0.21	0.11	-0.18	
Intercept	5.42	0.18		
Log restricted-likelihood	-3991.42			
Random Effects				
School variance	0.06		0.02	
Residual variance	1.31		0.04	
Intra-school correlation (ICC)	0.0433			
Null model				
School variance	0.36		0.06	
Residual variance	1.58		0.05	
Intra-school correlation (ICC)	0.1887			
% Reduction school variance	84%			
% Reduction pupil variance	17%			
% Reduction total variance	29%			

Table 7.6: Contextualised Models for Science Teacher Assessment Levels in Year 9 (Original Data): Primary School Mobility

	Year 9 Science TA Original Data			
Number of pupils	**2459**			
Number of schools	**532**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.01	0.15	*
Gender (compared to boys)	0.03	0.04	0.04	
Birth weight (compared to normal)				
Very Low Weight	-0.29	0.16	-0.32	
Low Birth Weight	0.03	0.08	0.03	
Missing	0.25	0.16	0.28	
Ethnic groups (compared to White UK Heritage)				
White European	0.16	0.11	0.18	
Black Caribbean	-0.11	0.11	-0.12	
Black African	-0.13	0.14	-0.15	
Other Ethnic Minority	0.24	0.13	0.27	
Indian	0.24	0.14	0.27	
Pakistani	0.07	0.12	0.07	
Bangladeshi	0.31	0.21	0.34	
Mixed Heritage	-0.03	0.09	-0.03	
Early Developmental Problems (compared to none)				
1+ Developmental Problem	-0.14	0.06	-0.15	*
Missing	-0.22	1.02	-0.24	
Mother's Age	0.05	0.03	0.08	
FSM in Year 9 (compared to none)				
Eligible for FSM	-0.27	0.06	-0.30	*
Missing	-0.16	0.20	-0.18	
Family Salary (compared to 'no salary')				
2,500 – 15,000	-0.03	0.07	-0.03	
17,500 – 27,500	0.08	0.07	0.08	
30,000 – 37,000	0.00	0.08	0.00	
37,500– 66,000	0.09	0.08	0.10	
+67,500	0.19	0.13	0.20	
Missing	0.04	0.07	0.04	
Family Socio Economic Status (compared to the Highest)				
Other professional non manual	-0.07	0.09	-0.08	
Skilled non manual	-0.21	0.10	-0.23	*
Skilled manual	-0.31	0.11	-0.34	*
Semi skilled	-0.28	0.11	-0.30	*
Unskilled	-0.26	0.16	-0.29	
Unemployed: not working	-0.07	0.16	-0.08	
Missing	-0.55	0.34	-0.60	
Mother's Qualification (compared to none)				
Vocational	0.23	0.07	0.25	*
Academic age 16	0.26	0.06	0.28	*
Academic age 18	0.44	0.09	0.48	*
Degree or Higher Degree	0.55	0.09	0.61	*
Other professional / Miscellaneous	0.52	0.17	0.57	*
Missing	0.26	0.18	0.28	
Father's Qualification (compared to none)				
Vocational	0.18	0.07	0.20	*
Academic age 16	0.20	0.06	0.22	*
Academic age 18	0.26	0.09	0.29	*
Degree or Higher Degree	0.43	0.09	0.47	*
Other professional / Miscellaneous	0.16	0.19	0.18	
Absent Father	0.12	0.06	0.13	*
Missing	-0.55	0.38	-0.61	
Early Years HLE (compared to 0 – 13)				
14 – 19	0.02	0.07	0.02	
20 – 24	0.11	0.08	0.12	

25 – 32	0.19	0.08	0.20	*
33 – 45	0.37	0.09	0.41	*
Missing	0.02	0.15	0.02	
KS1 HLE Enrichment Outings (compared to low)				
Medium KS1 HLE	0.13	0.05	0.15	*
High KS1 HLE	0.11	0.08	0.12	
KS2 HLE Individual Activities (compared to low)				
Medium KS2 HLE	0.16	0.04	0.17	*
High KS2 HLE	0.02	0.07	0.02	
FSM school level	-0.01	0.00	-0.20	*
% White British	-0.005	0.001	-0.24	*
IMD 2004	-0.003	0.001	-0.13	*
KS1- KS2 mobility (compared to no mobility)				
KS1 mobility	-0.07	0.06	-0.08	
KS2 mobility	-0.13	0.06	-0.15	*
Both KS1 and KS2 mobility	-0.07	0.11	-0.08	
Mobility between KS1 and KS2	-0.10	0.09	-0.11	
Intercept	4.87	0.14	5.36	*
Log restricted-likelihood	-3374.48			
Random Effects				
School variance	0.04		0.01	
Residual variance	0.82		0.03	
Intra-school correlation (ICC)	0.0433			
Null model				
School variance	0.30		0.04	
Residual variance	0.99		0.03	
Intra-school correlation (ICC)	0.2366			
% Reduction school variance	88%			
% Reduction pupil variance	17%			
% Reduction total variance	34%			

7.1. The Impact of Combined Terms of Mobility and FSM on KS3 Outcomes

The combined terms of primary school mobility (i.e., any mobility in KS1, KS2 or between KS1 and KS2) and Year 6 FSM were created and tested in contextualised models that controlled for the influence of a range of pupil and family background characteristics, HLE, neighbourhood disadvantage and school level FSM. The results showed that pupils who were eligible for FSM and moved primary schools in KS1 and/or KS2 obtained lower levels of TA in all three KS3 outcomes. However, the effect of mobility on pupils with FSM is more evident on the results in Mathematics and Science (see Table 7.7).

Table 7.7: Contextualised Models for Year 9 Cognitive Attainment: Mobility and Year 6 FSM

	Year 9 English TA				Year 9 Mathematics TA				Year 9 Science TA			
Number of pupils	**2421**				**2458**				**2423**			
Number of schools	**521**				**524**				**522**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Mobility and Year 6 FSM (compared to No Mobility- No FSM)												
No mobility-Yes FSM	-0.26	0.06	-0.31	*	-0.21	0.09	-0.18	*	-0.14	0.07	-0.15	*
Mobility- No FSM	-0.07	0.04	-0.08		-0.18	0.06	-0.16	*	-0.10	0.05	-0.11	*
Mobility – Yes FSM	-0.29	0.08	-0.35	*	-0.44	0.10	-0.38	*	-0.28	0.08	-0.31	*
Log restricted-likelihood	-3111.89				-3935.18				-3326.09			
Random Effects												
School variance	0.06				0.05				0.03			
Residual variance	0.67				1.32				0.83			
Intra-school correlation (ICC)	0.0791				0.0375				0.0397			
Null model												
School variance	0.29				0.36				0.30			
Residual variance	0.89				1.57				0.98			
Intra-school correlation (ICC)	0.2397				0.1887				0.2366			
% Reduction school variance	80%				86%				89%			
% Reduction pupil variance	25%				16%				16%			
% Reduction total variance	38%				29%				33%			

8. Summary and Conclusions

This report provides a detailed investigation of the cognitive attainments of the EPPSE sample of pupils at the end of KS3. It builds on earlier research that has followed this group from early childhood at age 3 years through primary school and into secondary school up to age 14.

Previously the project has demonstrated that a range of factors related to child and family characteristics and the home learning environment are important predictors of children's cognitive attainments and progress up to the end of primary school (Sammons et al., 2008a; Sylva et al., 2010). The impact of these influences can be detected from a young age and can also affect later educational attainment. The variations in achievement point to the negative effects of socio-economic disadvantage and the results of the research have contributed to policy developments in England associated with issues of equity and social inclusion (see The Equalities Review, 2007).

This current follow up of the sample in adolescence (Year 9 age 14) provides new evidence about the size of the equity gap in attainment as measured by teachers' judgements of pupil attainment in the three 'core' curriculum areas of English, mathematics and science (reflected by differences in TA levels).

In contrast to earlier research on this sample (during KS2), it was not possible to study variations in pupils' KS3 attainment using national assessment test scores as outcomes, due to a change in education policy. Instead, the analyses presented in this report are based on TA judgments that are less finely differentiated than test scores and tend to reflect greater subjective bias due to possible 'halo effects' (see Bew, 2011; Harlen, 2004). However, teacher judgments of attainment in Year 9 is likely to play an important role in shaping pupils' future educational decisions and subject choices in KS4 and therefore, can be viewed as important measures of educational outcomes to investigate.

The analyses in this report identify which child, family and home learning factors predict EPPSE pupils' KS3 outcomes. The results show similarities to earlier findings for this sample. A brief summary of the main findings is presented. While many results on the impact of gender, parents' qualifications or SES are in accord with those from other educational research studies, EPPSE also reveals the continued importance of the early years Home Learning Environment (HLE). The EPPSE project is unique in its exploration of the influence of this factor across different phases of pupils' education and has identified the way that the early years HLE continues to predict attainment up to age 14. In addition, the latest research discussed in this report demonstrates that various family background factors continue to influence pupils' academic progress across KS3. It should be noted that in the progress analyses, prior attainment in national assessment tests taken at the end of primary education (Year 6, KS2) was used included as a baseline in the statistical models.

This report focuses on statistical trends and quantitative analyses of factors that predict attainment and progress in KS3 based on results using multilevel statistical models. Elsewhere, EPPSE has reported (in keeping with the mixed methods research design involving both quantitative and qualitative approaches) findings from qualitative case studies of children and families that are more educationally successful in overcoming disadvantage (see Siraj-Blatchford et al., 2011). The qualitative data helps to provide a broader understanding of the way social disadvantage shapes pupils' educational outcomes and experiences at different ages and what factors help to protect against the adverse consequences of disadvantage.

As well as investigating the impact of child, family and HLE background, the EPPSE research has explored the continued influence of pre-school and primary school as predictors of pupils' later attainment at age 14 and also tested a range of measures related to secondary school experiences. The results, therefore, provide new evidence on the way different educational settings (pre-school, primary and secondary school) affect attainment and progress in KS3.

In order to maximise the sample size in our analyses, multiple imputation of missing data was used. Careful comparison of the results from both imputed and non imputed data sets were conducted and indicate that the results are robust producing very similar and the patterns consistent.

Raw Differences in Attainment for Different Pupil Groups

Overall, EPPSE pupils' had higher average attainments in mathematics than in either science or English (a difference of around 0.5 of a national curriculum level comparing mathematics and English, and 0.36 of a level comparing mathematics and science) at the end of KS3. This pattern of higher results in mathematics is in line with the most recent international TIMSS survey (Martin et al., 2008; Mullis et al., 2008; Sturman et al., 2008) of mathematics and science achievement that revealed England as the highest performing country in Europe in mathematics with the most improved results since 1995. It is likely that this improvement is linked with the introduction of the National Numeracy Strategy in 1998 (DfEE, 1998). In interpreting the KS3 results, it should be noted that EPPSE pupils had experienced the numeracy strategy in their primary education.

Gender

In Year 9, girls had higher attainment in terms of average TA English results than boys by around 0.4 of a national curriculum level (approximately half a standard deviation in size), but there were no significant gender differences in mathematics or science results. At younger ages, girls had been shown to have higher attainment in Reading and English and there were also smaller differences in mathematics and science outcomes in primary school but by age 14 these differences have disappeared.

Ethnicity

There was some evidence of ethnic differences in attainment but due to low numbers for most groups in the EPPSE sample the results should be interpreted with caution. Nonetheless, the differences found in average results by ethnic group are in line with those evident in other studies indicating higher attainment for some groups e.g. Indian and lower for others e.g. those from Pakistani heritage.

Family Characteristics

There were marked differences in attainment related to parents' qualification levels. As might be anticipated, pupils with highly qualified parents (degree level) had much higher attainment on average than those pupils whose parents had no qualification (the difference was equivalent to 1.4 TA levels for English, 1.7 for mathematics and 1.5 for science).

There were similarly large differences related to family socio-economic status (SES) between those from professional non-manual and those from lower SES categories. Moreover, pupils eligible for Free School Meals (FSM) had lower average attainment than pupils who were not eligible for FSM. The differences were around 0.7 and 0.8 of a national curriculum level in each subject.

Differences in the Early Years HLE were also associated with later differences in average attainment Year 9. The difference for English and science was approximately 1 national curriculum level, for mathematics it was 1.3 of a level for those of high versus low scores.

The Net Impact of Child, Family and HLE Factors on Attainment in Year 9

The average group differences described above do not take into account the relative influence of other characteristics. Multilevel modelling provides more detailed results of the 'net' contribution of individual factors, whilst controlling for other predictors and so enables the identification of the 'strongest' net predictors. For instance, we show the higher attainment in students with mothers who have degrees compared to those with no qualifications, net of the influence of other family and child factors (SES, income, HLE or gender).

Our findings are summarised in Table 8.1.

Table 8.1: Summary of Background Factors and Pre-, Primary and Secondary School Influences on Cognitive Attainment in Year 9
(Only the largest effect sizes for the original data are reported; comparison group in brackets)

	English	Mathematics	Science
Pupil characteristics			
Age (continuous)	0.19	0.15	0.16
Gender (boys)	0.46	ns	ns
Birth weight (normal)	-0.37	-0.40	-0.35
Ethnicity[†] (White UK heritage)	ns	0.37	0.30
Early developmental problems (none)	-0.21	-0.16	-0.15
Early behavioural problems (none)	-0.18	-0.18	ns
Number of siblings (none)	-0.31	-0.19	ns
Family characteristics			
Mother's age (continuous)	0.16	ns	0.09
Mother's qualification level (none)	0.61	0.50	0.61
Father's qualification level (none)	0.36	0.37	0.48
Free school meals (FSM) (non-FSM)	-0.30	-0.31	-0.31
Family SES (professional non-manual)	-0.29	-0.36	-0.31
Family earned income (none)	0.40	0.21	0.29
School level FSM (continuous)	-0.19	-0.20	-0.22
Home Learning Environment (HLE)			
Early years HLE (low)	0.29	0.38	0.41
Key Stage 1 HLE (low)	0.24	ns	0.15
Key Stage 2 HLE (low)	0.19	0.17	0.17
Pre-school*			
Attending (not attending)	ns	0.26	0.22
Pre-school quality*			
ECERS-E (no pre-school)	ns	0.28	0.23
ECERS-R (no pre-school)	ns	ns	ns
Pre-school effectiveness*			
Early number concepts (no pre-school)	ns	0.36	0.33
Pre-reading (no pre-school)	0.20	ns	ns
Primary School Effectiveness**			
English	ns		
Mathematics		0.31	0.29
Science			0.24
Secondary School Quality			
Quality of pupils' learning (inadequate)	0.42	0.56	0.51
Learners' attendance (inadequate)	0.70	0.71	0.56

[†] The number of EPPSE students in minority ethnic group categories is typically small. Thus, any differences for specific groups must be interpreted with caution.
*The reference group for all pre-school quality and effectiveness comparisons is the 'home' group, who had very little or no pre-school experience. The effect sizes represent differences between the 'home' group and the 'high quality/effectiveness' group unless stated otherwise.

** The reference group for primary school is 'low effectiveness'. The effect sizes represent differences between the 'low effectiveness' group and the 'high effectiveness' group.

Mother's qualification level was the strongest predictor of better attainment for English, maths and science. The next strongest predictor was gender but for English only, where the effect was larger in KS3 than was the case when these students were in primary school.

There were also a number of additional strong/moderately strong predictors as follows for:
English: family income, birth weight, father's highest qualification level, and the Early Years HLE;
Mathematics: birth weight, Early Years HLE, father's qualification level, ethnicity and family SES;
Science: father's qualification level, Early Years HLE, family SES and ethnicity.

It should be noted that ethnicity was not a significant predictor of TA levels in English, but it was for mathematics and science; pupils of Indian heritage obtained significantly better results in mathematics and science than White British pupils. Both FSM (the low income indicator) and family SES also have moderate effects on English, mathematics and science. These effects were similar in size to the effects of the Early Years and KS1 HLE for English. The Early Years HLE had a stronger impact on pupils' KS3 mathematics and science attainment than the low income indicator FSM.

Older students (for their age group e.g. Autumn born) also showed better results though the effect was not strong. There were also small positive effects related to the age of the child's mother (at birth); the older the mother then the better the outcomes, compared to children of younger mothers.

There is evidence that the 'social composition' of the school (as measured by the percentage of students entitled to free school meals, an indicator of poverty) can affect individual pupil's outcomes over and above their own FSM status. EPPSE students who attended a secondary school with higher proportions of students receiving FSM showed poorer attainment in English, maths and science, although the effects were relatively weak.

These results broadly confirm patterns identified at younger ages indicating that differences in attainment related to individual pupil and family background influences emerge early (at age 3) and remain fairly stable as pupils progress through primary and secondary school. The results supporting this conclusion are well established in previous social and educational research.

Neighbourhood Influences
A number of neighbourhood measures were tested as potential predictors of pupils' KS3 cognitive attainments. Previous research has suggested that contextual influences outside the family (such as school and neighbourhood composition) may influence student attainment. Living in a disadvantaged area and attending a school with a higher representation of disadvantaged pupils, may affect pupil and family aspirations and attitudes to education and also teacher expectations.

The DfE's national Contextual Value Added (CVA) measure of school performance has demonstrated that the school measure (percentage of FSM pupils) and neighbourhood measures such as the IMD and IDACI score predict pupil progress. As noted above the percentage of pupils on FSM in a secondary school also predicted attainment for the EPPSE sample.

Levels of neighbourhood disadvantage (measured by the IMD - Noble et al., 2004; and IDACI - Noble et al., 2008) were also significant predictors of lower student attainment in English and science in Year 9. This was not the case during the primary school years, possibly because neighbourhood influences increase as adolescents interact more with their peer group outside the home. Students who live in disadvantaged neighbourhoods had poorer attainment, over and above their own and their family characteristics, although these neighbourhood effects are relatively small compared to those of the family.

Other neighbourhood measures were also obtained by the EPPSE research. These included the level of employment and the percentage of residents with limiting long term illnesses, but neither of these was found to predict pupils' attainment. In contrast, the percentage of the population who were classed as White British was statistically significant with small negative effects for each subject. The level of crime recorded in a neighbourhood was also found to have small negative effects on attainment and progress in English and science. Similarly, parents' perceptions of the safety of their neighbourhood also showed small positive effects on attainment (mathematics and science) and progress (science).

Taken together the results indicate attainment was lower for pupils who lived in more disadvantaged neighbourhoods compared to those in more advantaged neighbourhoods, over and above their own and their family characteristics. The neighbourhood influence though relatively small seems to have become stronger in as the EPPSE sample go through early adolescence.

Pre-school

The EPPSE research was designed to follow up children recruited at pre-school into primary and later secondary school in order to identify and investigate the contribution of different educational influences on their later progress and development in different phases of education. In addition to investigating individual pupil, family, home learning and neighbourhood, further analyses sought to establish whether pre-school influences identified as significant predictors of attainment and progress in both cognitive and social behavioural outcomes at younger ages still show effects nine years later when the variation in attainment is studied up to age 14 years.

Three measures were tested: whether or not the pupil had **attended** a pre-school (a comparison with the 'home' group); the **quality** of the pre-school attended (as measured by the ECERS-R and E environmental rating scale instruments) and the **effectiveness** of the pre-school attended.

Attendance

Just having attended a pre-school was found to be a statistically significant predictor of better attainment in both maths and science (but not English) at the end of KS3, compared with the 'home' group. Although relatively weak (ES=0.26 for mathematics and ES=0.22 for science), these effects were still stronger than those found for 'age' (being Autumn born) and similar to the effect for family income (in both mathematics and science).

Quality

The quality of pre-school also continued to predict better outcomes in mathematics and science nine years after leaving pre-school. The effects of medium and high quality were slightly larger than for low quality (compared to 'home' group). For example, the ES for high quality was 0.28 for mathematics. In science, only those who had attended a medium or high quality pre-school continued to show significantly better attainment than the home group in TA levels at age 14.

Effectiveness

The indicator of pre-school effectiveness in promoting pre-reading skills continued to predict better outcomes in English in lower secondary school. However, only the highly effective category was statistically significant (ES=0.20) in predicting better attainment when compared to the 'home' group.

For mathematics, all groups (ES=0.36 for high; ES=0.22 for medium; and ES=0.30 for low effectiveness) had significantly better results than the 'home' group after controlling for other factors. For science, attending a high (ES=0.33) or medium effective (ES=0.19) pre-school (in promoting early number concepts) predicted significantly better outcomes than not attending a pre-

school. Those attending a low effective pre-school showed no better outcomes in science by the end of KS3 than the 'home' group.

Primary School Influence

Previous EPPSE research has shown that the academic effectiveness of a child's primary school is a statistically significant predictor of better attainment and progress across KS2 for English and more strongly for maths. Other educational effectiveness research has shown that primary schools can continue to influence students' longer term academic outcomes at secondary school (Goldstein & Sammons, 1997; Leckie, 2009). Measures of the academic effectiveness[2] in English and maths of the primary school attended by the EPPSE students were explored to see whether they had a positive influence on later attainment at the end of KS3. The KS3 analyses reveal that the academic effectiveness of the primary school the EPPSE students had attended still predicted better outcomes for both maths and science attainment three years after transferring to secondary school.

Controlling for pupil, family and HLE background characteristics, by the end of KS3, the extra benefit of attending a medium effective primary school was relatively small compared with the low effective group (ES=0.13 for maths & 0.10 for science). The net effects of attending a high academic effective primary school on later attainment compared with the effects of attending a low effective one were rather stronger (ES=0.31 for maths & 0.29 for science). The effects are similar in size to those attributable to FSM. The effect in terms of TA levels is a third of a level for maths and a quarter of a level for science.

Combined effects of phases of education

Pre-school and HLE

Further analyses also explored joint effects of pre-school and the Early Years HLE. The results showed that those with a low Early Years HLE obtained better outcomes in terms of later English, mathematics and science if they had attended a pre-school. The net differences were equivalent to between 0.4 and 0.7 of a national curriculum level (ES=0.37 for English; ES=0.56 for mathematics and ES=0.48 for science).

The quality of the pre-school measured by ECERS-E no longer showed differences in relation to pupils' Early Years HLE for English, mathematics or science in Year 9, in contrast to findings from the primary school.

There was an indication that the effectiveness of the pre-school in promoting early number concepts mattered in the study of joint effects for later science in Year 9. Here for both the low and the high HLE group there was evidence of a trend. Those with a low Early Years HLE showed particular benefits if they had previously attended a high effective pre-school (ES=0.61) showing similar results in terms of boost to those who had a medium or high HLE who had not attended pre-school. These results again suggest that high effective pre-school experience may have some compensatory benefits in promoting better later cognitive outcomes in science up to age 14.

Primary-school effectiveness and parent's qualification level

Further analyses explored joint effects for different pupil groups. For pupils whose parents had low educational qualifications, the boost in mathematics predicted from attending a high effective primary school compared with a low effective one was also larger (difference in ES=0.33) than the boost provided for pupils of parents with higher qualification levels (difference in ES=0.17). A similar pattern of results was found for science Year 9 TA levels. This suggests some continuing compensatory impact of previous attendance of a more academically effective primary school for pupils whose parents have lower educational qualifications.

Primary school and pre-school

The joint effects of pre-school quality and the primary school effectiveness were also investigated. These also pointed to the continued benefits of primary school academic effectiveness even when pre-school effects are taken into account for both mathematics and science outcomes in Year 9.

Pre-school effectiveness (in promoting early number concepts) was tested jointly with the primary school academic effectiveness measure and the results indicated that attending a high effective pre-school offered some protective effects (even if a student went on to a less effective primary school) for later maths and science outcomes. Likewise, having attended a more academically effective primary school mitigated the effects of experiencing no or only a low effective pre-school. The longer term protective effects of pre-school effectiveness were shown most clearly for students who then attended a low academically effective primary school when we studied their later attainment in Year 9 of secondary school.

Secondary and pre-school effectiveness
Further analyses of the combined effects showed that the continued benefits of pre-school were most evident for EPPSE students who went on to attend medium or low effective secondary schools, suggesting a protective influence of pre-school against attending an ineffective secondary school.

Transition from Primary to Secondary School
A subsample of approximately 550 EPPSE pupils and parents were asked about their personal experiences and views related to the transition from primary to secondary school, including their settling down in the new school, the academic work, their friendships and things that primary/secondary schools did to assist or smooth the transition. Five factors were identified to be deemed salient in the transition (Evangelou et al., 2008 for full details):

- Developing friendship, self-esteem and confidence
- Settling into school life
- Showing interest in school and schoolwork
- Getting used to new routines
- Experiencing curriculum continuity

EPPSE examined the importance of the transition experience on subsequent achievement and found that, those students who settled quickly into school routines and who experienced continuity in the curriculum from primary to secondary school made better progress in maths and science across KS3 and also had higher attainment in all three core subjects at Year 9. Although statistically significant, these effects were relatively small (ES range between 0.21 and 0.32). Other transition factors were less predictive of school-success, suggesting that familiarity with the school building and routines, along with familiar curriculum materials in lessons were more important during transition than the psychological dimensions of self-esteem and confidence or the social dimension of settling into school (social) life.

Primary School Mobility
The present report also explored the relationships between mobility during KS1 and KS2 in primary school and pupils' later cognitive outcomes in KS3. Results showed that mobility during KS2 was a negative predictor of Year 9 TA levels in English, mathematics and science. Pupils who had changed primary school only during KS2 obtained lower levels of Year 9 TA in all three core areas of the curriculum English, mathematics and science, even when the analyses controlled for the influence of a range of pupil and family background characteristics, HLE, neighbourhood disadvantage and school level FSM. Additionally, for mathematics, mobility during KS1 was also found to be a negative predictor of lower levels of TA in Year 9. Pupils who had moved primary schools during KS1 obtained significantly lower levels of TA in mathematics in Year 9 than pupils who had not moved at all.

Overall, these analyses of EPPSE pupils' attainment in English, mathematics and science in Year 9 has provided a wide range of evidence concerning the factors that predict attainment in Year 9 as measured by TAs, and also progress across KS3.

Secondary School Influences

We tested the academic effectiveness of secondary schools using CVA measures derived from the DfE's National Pupil Database. These measures show the relative progress made by pupil intakes measured from KS2 to KS4 (across 5 years). In contrast to our primary school academic effectiveness measure that examined results in English, mathematics and science separately (Melhuish et al., 2006), we did not have subject specific results for these secondary school CVA indicators. The secondary school CVA measure of effectiveness did not predict EPSSE pupils' differences in attainment in Year 9, after controlling for individual pupil, family and HLE measures.

However, after controlling for the same characteristics, the quality of secondary school measured by Ofsted inspection ratings on the 'quality of pupils' learning' was a statistically significant predictor of attainment in both English and science, with the difference being only statistically significant (but moderately strong) for the 'outstanding' schools category compared with the 'inadequate' category (ES= 0.42 English, ES=0.51 science).

For mathematics, schools judged by Ofsted as 'good' (on quality of learning) showed more modest but significant positive effects (ES=0.26) and those judged as 'outstanding' showed stronger effects (ES=0.56) compared with the 'inadequate' category.

These results support the hypothesis that secondary school quality remains important in shaping pupils' cognitive attainment, over and above the impact of background factors. The effects are equivalent to between 0.34 and 0.64 of a TA level for those who attended an 'outstanding' rather than an 'inadequate' school (in terms of the Ofsted judgement 'quality of learning'). A similar strong pattern was identified for Ofsted judgments of learners' attendance. It should be noted that these two Ofsted measures (quality of learning and learners attendance) are also correlated.

Pupils' Progress across Key Stage 3

Pupils' academic progress across KS3 was studied by controlling for the prior attainment at the end of primary school and taking account of individual pupil, family and HLE factors. Fewer background factors predicted progress across KS3 than were significant for attainment. The patterns were similar to those found to be at younger ages when we studied pupils' progress across KS2 for this sample.

Overall, there was evidence that pupils (see Table 8.2):

- older for their year group (Autumn born) (ES=0.24-English, ES=0.32-maths and ES=0.20-science),
- girls (ES=0.32-English, ES=0.16-maths and ES=0.17-science),
- with highly qualified fathers (ES=0.28-English, ES=0.28-maths and ES=0.43-science),

made more progress in English, maths and science over KS3.

Students whose mothers were highly qualified (degree/higher degree) made better progress in English (ES=0.34) and science (ES=0.33). Additionally, students whose families had high incomes also made better progress in English (ES=0.39). There were small negative effects related to early behavioural problems, and eligibility for FSM.

A higher percentage of students in a school eligible for FSM predicted poorer progress for the EPPSE sample in both English (ES=0.18) and science (ES=0.21). Of the neighbourhood measures tested, only the percentage of White British and the level of reported crime were significant predictors of poorer student progress in English. For progress in science however, reported crime, perceived neighbour safety, the IMD and IDACI were statistically significant predictors. These findings indicate that the disadvantage of the school's intake and pupils' neighbourhood

characteristics had small negative effects predicting both poorer progress and attainment and shows that schools in some areas face more challenging circumstances in improving student learning outcomes.

Neither the pre-school measures nor the primary school academic effectiveness measure were significant predictors of pupils' progress in KS3. However, the secondary school overall academic effectiveness indicator was found to be a statistically significant predictor for progress in English.

Higher Ofsted measures of the 'quality of pupils' learning' and 'attendance of learners' also proved to be significant predictors of better progress in all three core subjects. EPPSE students who attended an 'outstanding' secondary school in terms of the 'quality of learning' made significantly more progress in the three core subjects than those in schools judged to be 'inadequate' (ES ranged between 0.29 and 0.36). Additionally, students from secondary schools characterised as 'outstanding', 'good' or even 'satisfactory' in terms of 'pupils' attendance' made significantly more progress in English (ES=0.48 for outstanding) and mathematics (ES=0.35 for outstanding). These findings provide some evidence of external validity for the use of Ofsted inspection judgments and are in line with earlier results on a sub-set of primary schools investigated as part of the EPPE 3-11 phase of the research (Sammons et al., 2008c).

Table 8.2: Summary of Background Characteristics on Academic Progress
(Only the largest effect sizes for the original data are reported; comparison group in brackets)

	English	Mathematics	Science
Pupil characteristics			
Age (continuous)	0.24	0.32	0.20
Gender (boys)	0.32	0.16	0.17
Birth weight (normal)			
Ethnicity (White UK heritage)		0.88	0.54
Early developmental problems (none)			
Early behavioural problems (none)	-0.15	-0.14	
Number of siblings (none)			
Family characteristics			
Mother's age (continuous)	0.13		0.15
Mother's qualification level (none)	0.34	0.13	0.35
Father's qualification level (none)	0.28	0.28	0.43
Free school meals (FSM) (non-FSM)	-0.19	-0.19	-0.15
Family SES (professional non-manual)			
Family earned income (none)	0.39		
School level FSM (continuous)	-0.18		-0.21

Pupils' experiences and views of secondary school

Pupils' secondary school experiences were measured using self-report questionnaires administered in Year 9. Various measures of school experiences were identified and tested to see if they predicted variations in pupils' KS3 academic attainment and progress after control for individual, family and HLE factors, including the percentage of pupils on FSM in the school.

The results indicate that students who perceived their school to place higher 'emphasis on learning' had significantly higher attainment. The difference was between half in English and science to three quarters of a TA level for mathematics (ES ranged between 0.20 and 0.22).

EPPSE pupils' attainment was also found to be higher where they perceived a more positive 'behaviour climate' in their secondary school. The difference was particularly noticeable for

mathematics (ES=0.46). The perceived 'quality of their school environment'[32] was also a predictor of better attainment, although the effects were smaller and only significant for maths and science (ES=0.13 for both). Similar, small but positive effects were identified for the factor related to students' perceptions of how much they felt teachers' valued and respected them. Finally, the factor 'learning resources' (related to whether students felt the school was well equipped with computers and technology) also predicted better attainment in maths (ES=0.13) and science (ES=0.15) in KS3. Although the effect sizes are relatively small, this is the equivalent of around half a TA level for both these subjects.

After testing these factors separately as predictors of attainment, we also tested them together to investigate which ones are the most important in predicting cognitive outcomes in Year 9 when still controlling for individual pupil, familial and HLE characteristics. . For all three core curriculum subjects, it was found that the two factors 'emphasis on learning' and 'behaviour climate' together significantly predicted Year 9 cognitive attainment.

Looking only at pupils' progress during KS3 'behaviour climate', 'valuing pupils' and 'teacher support' were significant predictors of progress in English, maths and science. 'School environment and 'learning resources' were only significant for maths and science. 'Headteacher qualities' was a significant predictor for progress in maths (ES=0.15). Finally, 'teacher behaviour management' was a significant predictor of progress in science (ES=0.14).

After control for individual, family and HLE influences, the daily time spent on homework, as reported by students, was found to be an important and strong predictor of better attainment and progress. The strongest effects were noted for those who reported 2-3 hours per day. For attainment in English this had an ES of 0.73 (equivalent to 0.6 of a TA level). For attainment in mathematics, the ES was 0.84 (equivalent to almost 1 TA level) similar to the effects for science (ES 0.85, equivalent to nearly 0.75 of a level). For academic progress in the three core subjects, the ES for 2-3 hours of homework/day ranged between 0.69 and 0.84. Spending more time on homework is likely to increase study skills and opportunities to learn, it may also be influenced by self-regulation. It is also likely to reflect secondary school policies and teacher expectations and the academic emphasis in the school as well as encouragement from parents to take school work seriously.

Students' views of themselves

Earlier EPPSE research (Sammons et al., 2008d) has shown positive relationships exist between academic self-concept and attainment. Higher academic self-concept predicts better attainment and vice versa. Patterns of attainment and self-concept in younger children can shape their future identities as learners. The results for EPPSE students in secondary school show fairly strong links between academic self-concept in maths as a predictor of attainment in Year 9 (ES=1.2; nearly 1 TA level). By contrast, academic self-concept in English was a weaker predictor of Year 9 English attainment (ES=0.74; equivalent to approximately a half of a TA level). Students' self-reported enjoyment of school, also predicted attainment, with stronger effects for maths (ES=0.38 mathematics; ES=0.31 science; ES=0.29 English).

[32] This factor includes attractive and well decorated buildings, cleanliness of toilets etc.

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Appendix 1: EPPSE Publications

The EPPSE website: http://eppe.ioe.ac.uk contains information on the sample, methodology, and many other aspects of the project. The website also contains links to the information listed below (see the 'Publications' sections of each phase of the study). For further information contact Brenda Taggart, Principal Investigator/Research Co-ordinator, 0207 612 6219, b.tagggart@ioe.ac.uk

The Pre-school phase:

End of pre-school phase report and research brief

Final report of the pre-school phase:
http://www.education.gov.uk/publications/eOrderingDownload/SSU-FR-2004-01.pdf
Research brief on the pre-school phase:
http://www.education.gov.uk/publications/eOrderingDownload/SSU-SF-2004-01.pdf

There are twelve technical papers associated with this phase of the research - see http://eppe.ioe.ac.uk
Technical Paper 1 (1999)
An Introduction to the Effective Provision of Pre-School Education (EPPE) Project.
Technical Paper 2 (1999)
Characteristics of the Effective Provision of Pre-School (EPPE Project sample at entry to the study.
Technical Paper 3 (1999)
Contextualising EPPE: Interviews with local authority co-ordinators and manager.
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Technical Paper 8a (2002)
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Appendix 2: Characteristics of the Sample in Year 9

Table A.2.1: Selected Characteristics of Sample with Valid Cognitive Data in Year 9 – Original Data

	Year 9 English Standardised Test Score N=1143		Year 9 Mathematics Standardised Test Score N=1186		Year 9 Science Standardised Test Score N=1186	
	N	%	N	%	N	%
Gender						
Male	586	51.3	615	51.9	613	51.7
Female	557	48.7	571	48.1	573	48.3
Ethnicity						
White European Heritage	34	3.0	36	3.0	37	3.1
Black Caribbean Heritage	31	2.7	32	2.7	31	2.6
Black African Heritage	22	1.9	25	2.1	25	2.1
Any Other Ethnic Minority Heritage	19	1.7	20	1.7	20	1.7
Indian Heritage	24	2.1	25	2.1	25	2.1
Pakistani Heritage	60	5.3	62	5.2	64	5.4
Bangladeshi Heritage	11	1.0	11	.9	11	.9
Mixed Heritage	58	5.1	60	5.1	62	5.2
White UK Heritage	883	77.3	914	77.1	910	76.8
Number of Siblings (age3/5)						
No siblings	216	19.2	230	19.7	229	19.6
1 - 2 siblings	726	64.5	743	63.6	743	63.6
3+ siblings	184	16.3	196	16.8	196	16.8
Early Years Home Learning Environment (HLE) Index						
<13	112	10.1	119	10.3	123	10.7
14-19	275	24.8	287	25.0	284	24.7
20-24	259	23.4	269	23.4	270	23.5
25-32	332	30.0	342	29.7	341	29.7
>33	129	11.7	133	11.6	132	11.5
Type of Pre-School						
Nursery class	471	41.2	483	40.7	482	40.6
Playgroup	191	16.7	202	17.0	201	16.9
Private day nursery	133	11.6	138	11.6	136	11.5
Local Authority day nursery	181	15.8	185	15.6	187	15.8
Nursery school	21	1.8	22	1.9	22	1.9
Integrated (Combined) centres	1	.1	1	.1	1	.1
Home	145	12.7	155	13.1	157	13.2

Table A.2.2: Selected Characteristics of Sample with Missing Cognitive Data in Year 9 - Original Data

	Missing Year 9 English Standardised Test Score N=1859		Missing Year 9 Mathematics Standardised Test Score N=1816		Missing Year 9 Science Standardised Test Score N=1816	
	N	%	N	%	N	%
Gender						
Male	957	51.5	928	51.1	930	51.2
Female	902	48.5	888	48.9	886	48.8
Ethnicity						
White European Heritage	76	4.1	74	4.1	73	4.0
Black Caribbean Heritage	78	4.2	77	4.2	78	4.3
Black African Heritage	39	2.1	36	2.0	36	2.0
Any Other Ethnic Minority Heritage	59	3.2	58	3.2	58	3.2
Indian Heritage	40	2.2	39	2.1	39	2.1
Pakistani Heritage	100	5.4	98	5.4	96	5.3
Bangladeshi Heritage	20	1.1	20	1.1	20	1.1
Mixed Heritage	123	6.6	121	6.7	119	6.6
White UK Heritage	1323	71.2	1292	71.2	1296	71.4
Number of Siblings (age3/5)						
No siblings	384	20.9	370	20.6	371	20.7
1 - 2 siblings	1170	63.7	1153	64.3	1153	64.3
3+ siblings	282	15.4	270	15.1	270	15.1
Early Years Home Learning Environment (HLE) Index						
<13	171	9.5	164	9.3	160	9.1
14-19	370	20.6	358	20.4	361	20.6
20-24	447	24.8	437	24.9	436	24.8
25-32	602	33.5	592	33.7	593	33.8
>33	209	11.6	205	11.7	206	11.7
Type of Pre-School						
Nursery class	109	5.9	97	5.3	98	5.4
Playgroup	396	21.3	385	21.2	386	21.3
Private day nursery	355	19.1	350	19.3	352	19.4
Local Authority day nursery	220	11.8	216	11.9	214	11.8
Nursery school	474	25.5	473	26.0	473	26.0
Integrated (Combined) centres	169	9.1	169	9.3	169	9.3
Home	136	7.3	126	6.9	124	6.8

Table A.2.3: Selected Characteristics of Sample with Valid Cognitive Data in Year 9 - Original Data

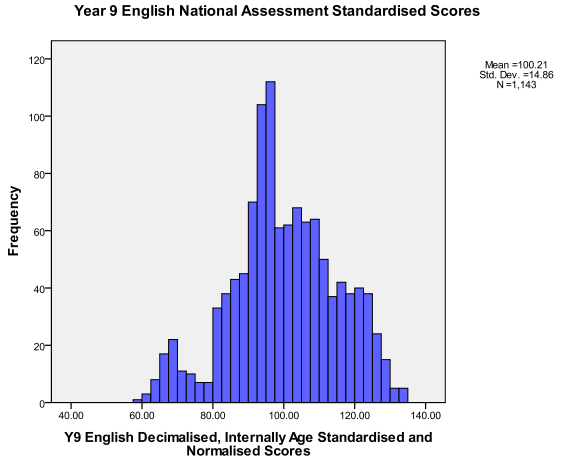
	Year 9 English Standardised Test Score N=1143		Year 9 Mathematics Standardised Test Score N=1186		Year 9 Science Standardised Test Score N=1186	
	N	%	N	%	N	%
Mother's Qualifications						
None	290	26.2	303	26.3	307	26.7
Vocational	139	12.5	147	12.8	145	12.6
16 Academic	435	39.3	450	39.1	449	39.1
18 Academic	82	7.4	84	7.3	83	7.2
Degree or Higher degree	148	13.4	151	13.1	150	13.1
Other professional	14	1.3	15	1.3	15	1.3
Father's Qualifications						
None	202	17.9	209	17.9	208	17.8
Vocational	114	10.1	117	10.0	117	10.0
16 academic	284	25.2	297	25.4	295	25.2
18 academic	85	7.5	86	7.4	86	7.4
Degree or Higher degree	144	12.8	147	12.6	146	12.5
Other professional	13	1.2	14	1.2	14	1.2
Absent Father	286	25.4	300	25.6	303	25.9
Family Highest SES (age3/5)						
Professional Non Manual	73	6.5	75	6.4	74	6.3
Other Professional Non manual	245	21.8	252	21.6	252	21.6
Skilled Non Manual	400	35.5	409	35.0	408	34.9
Skilled Manual	168	14.9	179	15.3	177	15.2
Semi-Skilled	180	16.0	190	16.3	192	16.4
Unskilled	27	2.4	28	2.4	29	2.5
Unemployed / Not working	33	2.9	36	3.1	36	3.1
FSM at Year 9						
No Free School Meals (FSM) (at Year 9)	915	80.4	945	80.1	944	80.0
Free School Meals (FSM) (at Year 9)	223	19.6	235	19.9	236	20.0
Family Earned Income at KS1						
No salary	235	25.9	243	25.9	246	26.2
£ 2,500 – 17,499	183	20.2	192	20.4	194	20.7
£ 17,500 – 29,999	166	18.3	172	18.3	169	18.0
£ 30,000 – 37,499	114	12.6	119	12.7	117	12.5
£ 37,500 – 67,499	170	18.7	174	18.5	172	18.3
£ 67,500 – 132,000+	40	4.4	40	4.3	40	4.3
SEN Status at Year 9						
No Special Provision	899	80.6	905	78.4	907	78.5
School Action	135	12.1	146	12.6	146	12.6
School Action Plus	64	5.7	73	6.3	68	5.9
Statement of SEN	18	1.6	31	2.7	34	2.9

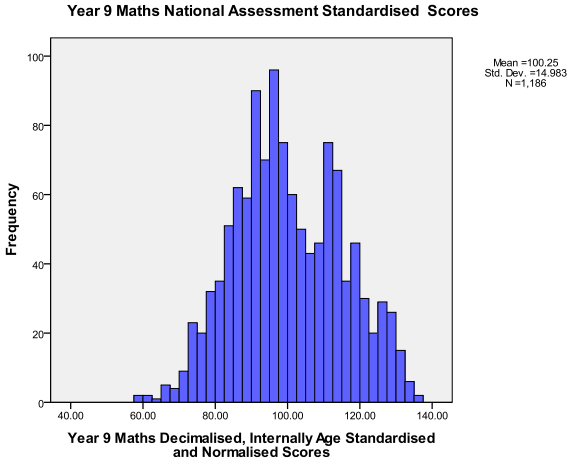
Table A.2.4: Selected Characteristics of Sample with Missing Cognitive Data in Year 9 - Original Data

	Missing Year 9 English Standardised Test Score N=1859		Missing Year 9 Mathematics Standardised Test Score N=1816		Missing Year 9 Science Standardised Test Score N=1816	
	N	%	N	%	N	%
Mother's Qualifications						
None	336	18.5	323	18.2	319	18.0
Vocational	295	16.3	287	16.2	289	16.3
16 Academic	658	36.3	643	36.3	644	36.3
18 Academic	160	8.8	158	8.9	159	9.0
Degree or Higher degree	336	18.5	333	18.8	334	18.8
Other professional	30	1.7	29	1.6	29	1.6
Father's Qualifications						
None	275	15.0	268	15.0	269	15.0
Vocational	223	12.2	220	12.3	220	12.3
16 academic	384	20.9	371	20.7	373	20.8
18 academic	130	7.1	129	7.2	129	7.2
Degree or Higher degree	364	19.9	361	20.2	362	20.2
Other professional	19	1.0	18	1.0	18	1.0
Absent Father	438	23.9	424	23.7	421	23.5
Family Highest SES (age3/5)						
Professional Non Manual	191	10.4	189	10.6	190	10.6
Other Professional Non manual	504	27.5	497	27.8	497	27.8
Skilled Non Manual	553	30.2	544	30.4	545	30.5
Skilled Manual	274	15.0	263	14.7	265	14.8
Semi-Skilled	210	11.5	200	11.2	198	11.1
Unskilled	47	2.6	46	2.6	45	2.5
Unemployed / Not working	51	2.8	48	2.7	48	2.7
FSM at Year 9						
No Free School Meals (FSM) (at Year 9)	1350	81.2	1320	81.4	1321	81.5
Free School Meals (FSM) (at Year 9)	313	18.8	301	18.6	300	18.5
Family Earned Income at KS1						
No salary	330	22.7	322	22.6	319	22.4
£ 2,500 – 17,499	297	20.4	288	20.2	286	20.1
£ 17,500 – 29,999	244	16.8	238	16.7	241	16.9
£ 30,000 – 37,499	157	10.8	152	10.7	154	10.8
£ 37,500 – 67,499	298	20.5	294	20.6	296	20.8
£ 67,500 – 132,000+	130	8.9	130	9.1	130	9.1
SEN Status at Year 9						
No Special Provision	1262	76.5	1256	78.0	1254	77.8
School Action	186	11.3	175	10.9	175	10.9
School Action Plus	123	7.5	114	7.1	119	7.4
Statement of SEN	79	4.8	66	4.1	63	3.9

Appendix 3: Descriptive Statistics of National Assessment Standardised Scores

Figure A.3.1: Distributions of Different Measures of Cognitive Attainment at Year 9 - Original Data





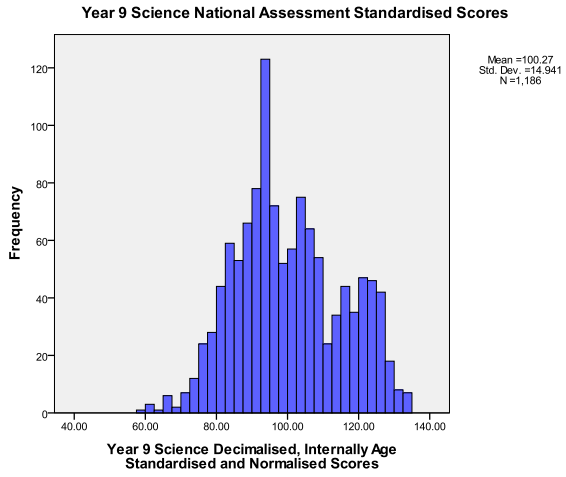


Table A.3.1: Descriptive Statistics of Cognitive Outcomes at Year 9 – Original Data

	N	Minimum	Maximum	Mean	Std. Deviation
Year 9 English National Assessment Standardised Scores	1143	59.21	134.81	100.21	14.86
Year 9 Mathematics National Assessment Standardised Scores	1186	57.90	135.72	100.25	14.98
Year 9 Science National Assessment Standardised Scores	1186	58.66	133.63	100.27	14.94
Total	3002				

Table A.3.2: Descriptive Statistics of Cognitive Outcomes at Year 9 – Multiple Imputation Data

	N	Minimum	Maximum	Mean	Std. Deviation
Year 9 English National Assessment Standardised Scores	3002	35.70	162.18	101.16	15.59
Year 9 Mathematics National Assessment Standardised Scores	3002	35.39	149.20	101.40	15.37
Year 9 Science National Assessment Standardised Scores	Not imputed				
Total	3002				

Appendix 4: Differences in Attainment for Different Groups of Pupils (National Assessment Data)

Table A.4.1: Gender Differences on Pupils' Scores on the Year 9 Cognitive Outcomes- Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	Gender	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	Male	97.2	15.2	586	98.7	1543
	Female	103.4	13.8	557	103.7	1459
Year 9 Mathematics National Assessment Standardised Scores	Male	100.3	15.6	615	101.5	1543
	Female	100.1	14.3	571	101.3	1459

Table A.4.2: Cognitive Attainment in Year 9 by Ethnic Groups – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	Ethnicity	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	White European Heritage	97.5	12.9	34	98.9	110
	Black Caribbean Heritage	101.1	16.9	31	100.7	109
	Black African Heritage	99.8	13.5	22	99.7	61
	Any Other Ethnic Minority	96.5	14.2	19	98.3	78
	Indian	105.4	16.6	24	102.1	64
	Pakistani	93.1	10.6	60	93.9	160
	Bangladeshi	94.6	23.1	11	97.4	31
	Mixed Race	97.3	17.9	58	100.2	181
	White UK Heritage	101.0	14.6	883	102.1	2206
Year 9 Mathematics National Assessment Standardised Scores	White European Heritage	97.5	14.8	36	100.7	110
	Black Caribbean Heritage	98.6	12.7	32	99.1	109
	Black African Heritage	97.1	14.1	25	99.0	61
	Any Other Ethnic Minority	99.3	12.5	20	100.9	78
	Indian	104.1	18.7	25	104.0	64
	Pakistani	93.0	13.7	62	94.1	160
	Bangladeshi	95.9	20.0	11	96.9	31
	Mixed Race	95.6	16.6	60	100.0	181
	White UK Heritage	101.3	14.8	914	102.3	2206

Table A.4.3: Cognitive Attainment in Year 9 by Mother's Highest Qualification – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	Mother's Highest Qualification	**Mean**	**Std. Dev.**	**N**	**Mean**	**N**
Year 9 English National Assessment Standardised Scores	None	93.0	13.8	290	93.1	651
	Vocational	101.1	14.6	139	100.3	448
	Academic Age 16	99.7	13.5	435	100.3	1120
	Academic Age 18	104.8	11.8	82	105.2	247
	Degree or Higher Degree	112.5	12.2	148	111.9	492
	Other professional	112.6	14.0	14	107.7	44
Year 9 Mathematics National Assessment Standardised Scores	None	92.8	12.7	303	93.7	651
	Vocational	99.6	14.3	147	100.0	448
	Academic Age 16	100.5	14.0	450	100.4	1120
	Academic Age 18	104.0	12.7	84	105.6	247
	Degree or Higher Degree	113.5	13.3	151	112.4	492
	Other professional	109.9	12.9	15	108.9	44

Table A.4.4: Cognitive Attainment in Year 9 by Family SES (Early Years) - Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	Family SES	**Mean**	**Std. Dev.**	**N**	**Mean**	**N**
Year 9 English National Assessment Standardised Scores	Professional Non Manual	111.0	12.0	73	112.1	266
	Other Professional Non Manual	107.4	13.0	245	106.8	756
	Skilled Non Manual	100.5	13.8	400	100.8	967
	Skilled Manual	95.1	13.5	168	95.2	450
	Semi Skilled	92.2	15.2	180	93.8	400
	Unskilled	92.5	12.0	27	91.2	76
	Never Worked	96.5	13.1	33	95.4	87
Year 9 Mathematics National Assessment Standardised Scores	Professional Non Manual	112.2	15.0	75	113.1	266
	Other Professional Non Manual	108.1	14.1	252	107.1	756
	Skilled Non Manual	99.7	13.7	409	100.5	967
	Skilled Manual	95.5	12.5	179	95.7	450
	Semi Skilled	92.9	13.9	190	94.5	400
	Unskilled	91.0	12.6	28	91.3	76
	Never Worked	97.4	14.6	36	96.8	87

Table A.4.5: Cognitive Attainment in Year 9 by Free School Meals – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	FSM	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	No FSM	102.2	14.1	915	103.0	2431
	FSM	92.0	15.3	223	93.1	571
Year 9 Mathematics National Assessment Standardised Scores	No FSM	102.3	14.7	945	103.3	2431
	FSM	92.2	13.3	235	93.5	571

Table A.4.6: Cognitive Attainment in Year 9 by SEN – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	SEN Status	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	No special provision	103.5	13.4	899	104.7	2346
	School action	87.4	12.2	135	90.4	348
	School action plus	85.9	13.5	64	89.0	204
	Statement of SEN	80.2	15.4	18	80.5	105
Year 9 Mathematics National Assessment Standardised Scores	No special provision	103.7	13.8	905	104.7	2346
	School action	88.7	11.6	146	91.2	348
	School action plus	89.2	13.4	73	90.4	204
	Statement of SEN	81.6	13.1	31	82.2	105

Table A.4.7: Cognitive Attainment in Year 9 by Early Years HLE Index – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	Early Years HLE	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	0-13	91.7	14.5	112	91.4	293
	14-19	97.2	14.2	275	97.3	665
	20-24	100.1	13.6	259	100.7	732
	25-32	102.2	14.6	332	103.9	965
	33-49	110.3	12.3	129	110.2	347
Year 9 Mathematics National Assessment Standardised Scores	0-13	92.9	13.3	119	93.3	293
	14-19	97.3	14.5	287	98.2	665
	20-24	100.0	14.5	269	100.7	732
	25-32	102.0	14.9	342	103.8	965
	33-49	109.4	13.7	133	109.3	347

Table A.4.8: Cognitive Attainment in Year 9 by KS1 HLE – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	KS1 HLE Computing	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	Low KS1 HLE	101.0	14.6	111	99.7	513
	Medium KS1 HLE	102.7	14.0	535	101.9	2036
	High KS1 HLE	98.7	14.5	129	99.1	453
Year 9 Mathematics National Assessment Standardised Scores	Low KS1 HLE	99.4	14.9	117	98.7	513
	Medium KS1 HLE	103.0	14.6	551	102.3	2036
	High KS1 HLE	101.0	14.4	132	100.4	453

Table A.4.9: Cognitive Attainment in Year 9 by KS1 HLE – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	KS1 HLE Interactions	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	Low KS1 HLE	102.0	15.4	159	100.1	460
	Medium KS1 HLE	102.0	13.8	540	101.5	2103
	High KS1 HLE	99.8	15.0	76	100.6	439
Year 9 Mathematics National Assessment Standardised Scores	Low KS1 HLE	102.5	15.3	165	100.4	460
	Medium KS1 HLE	102.5	14.4	553	101.8	2103
	High KS1 HLE	99.2	15.5	82	100.5	439

Table A.4.10: Cognitive Attainment in Year 9 by KS1 HLE – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	KS1 HLE Outings	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	Low KS1 HLE	91.9	12.5	93	93.9	457
	Medium KS1 HLE	103.1	13.9	599	101.8	2158
	High KS1 HLE	103.5	14.3	83	106.0	387
Year 9 Mathematics National Assessment Standardised Scores	Low KS1 HLE	91.2	9.4	95	93.9	457
	Medium KS1 HLE	103.4	14.7	619	102.1	2158
	High KS1 HLE	104.8	14.3	86	106.2	387

Table A.4.11: Cognitive Attainment in Year 9 by KS1 HLE – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	KS1 HLE Play	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	Low KS1 HLE	99.2	13.6	140	98.6	492
	Medium KS1 HLE	102.0	14.6	514	101.5	2016
	High KS1 HLE	103.5	13.3	121	102.3	494
Year 9 Mathematics National Assessment Standardised Scores	Low KS1 HLE	101.4	15.7	149	100.9	492
	Medium KS1 HLE	102.6	14.9	531	101.7	2016
	High KS1 HLE	100.9	12.2	120	100.9	494

Table A.4.12: Cognitive Attainment in Year 9 by KS2 HLE – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	KS2 HLE Educational Computing	Mean	Std. Dev.	N	Mean	N
Year 9 English National Assessment Standardised Scores	Low KS1 HLE	96.6	14.2	122	96.3	497
	Medium KS1 HLE	103.4	14.0	505	102.2	2072
	High KS1 HLE	103.3	13.7	86	101.6	433
Year 9 Mathematics National Assessment Standardised Scores	Low KS1 HLE	96.6	15.1	132	96.5	497
	Medium KS1 HLE	104.1	14.5	516	102.5	2072
	High KS1 HLE	103.5	14.7	90	101.9	433

Table A.4.13: Cognitive Attainment in Year 9 by KS2 HLE – Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	KS2 HLE Individual Activities	**Mean**	**Std. Dev.**	**N**	**Mean**	**N**
Year 9 English National Assessment Standardised Scores	Low KS1 HLE	95.9	14.0	112	96.2	466
	Medium KS1 HLE	103.2	14.1	497	101.8	2068
	High KS1 HLE	104.4	13.0	104	103.3	468
Year 9 Mathematics National Assessment Standardised Scores	Low KS1 HLE	98.7	14.8	118	98.1	466
	Medium KS1 HLE	103.6	15.0	514	101.9	2068
	High KS1 HLE	102.6	13.7	106	102.5	468

Table A.4.14: Cognitive Attainment in Year 9 by Pre-school Attendance - Original and Imputed Data

		Original Data			Imputed Data Pooled Sample	
	Pre-school Attendance	**Mean**	**Std. Dev.**	**N**	**Mean**	**N**
Year 9 English National Assessment Standardised Scores	Pre-school Experience	101.1	14.6	998	101.9	2721
	No Pre-school Experience	94.0	15.1	145	93.7	281
Year 9 Mathematics National Assessment Standardised Scores	Pre-school Experience	101.4	14.7	1031	102.2	2721
	No Pre-school Experience	92.7	14.5	155	93.3	281

Appendix 5: Early Years, KS1 and KS2 Home Learning Environment

The Early Years Home Learning Environment (HLE)

The EPPE Project - Pupils' activities at home

Does X have?

A regular bedtime
Rules about watching TV/videos
How often does X watch TV/videos in a typical weekday?

How many days in a typical week has X?

Played with friends at home
Does X have friends home to play?
Played with friends elsewhere
Does s/he go anywhere else to play?
Gone shopping with you
Gone on visits to friends or relatives
Sat down and eaten a meal with the whole family together

Does anyone at home ever read to X? If yes, how often?

Does anyone at home ever take X to the library? How often?

Does X ever play with letters or numbers? How often?

Does X ever paint and draw at home? How often?

Have you ever tried to teach X? ABC/ The Alphabet/ letters?
Numbers? How often?
Any songs/poems? How often?
Can you tell me which?
Any nursery rhymes? How often?
Can you tell me which?

The Key Stage 1 Home Learning Environment (HLE)

KS1 HLE Factors and the items loading on these factor:

- **Home Computing**
  - The Child plays on computer by themself.
  - Respondent plays computer games with the child.
  - Respondent uses computer with the child in educational ways.

- **Parent-Child Enrichment outings/activity outside home.**
  - Respondent visits library with the child.
  - Respondent does sport/physical activity with the child.
  - Respondent goes on educational visits with the child.

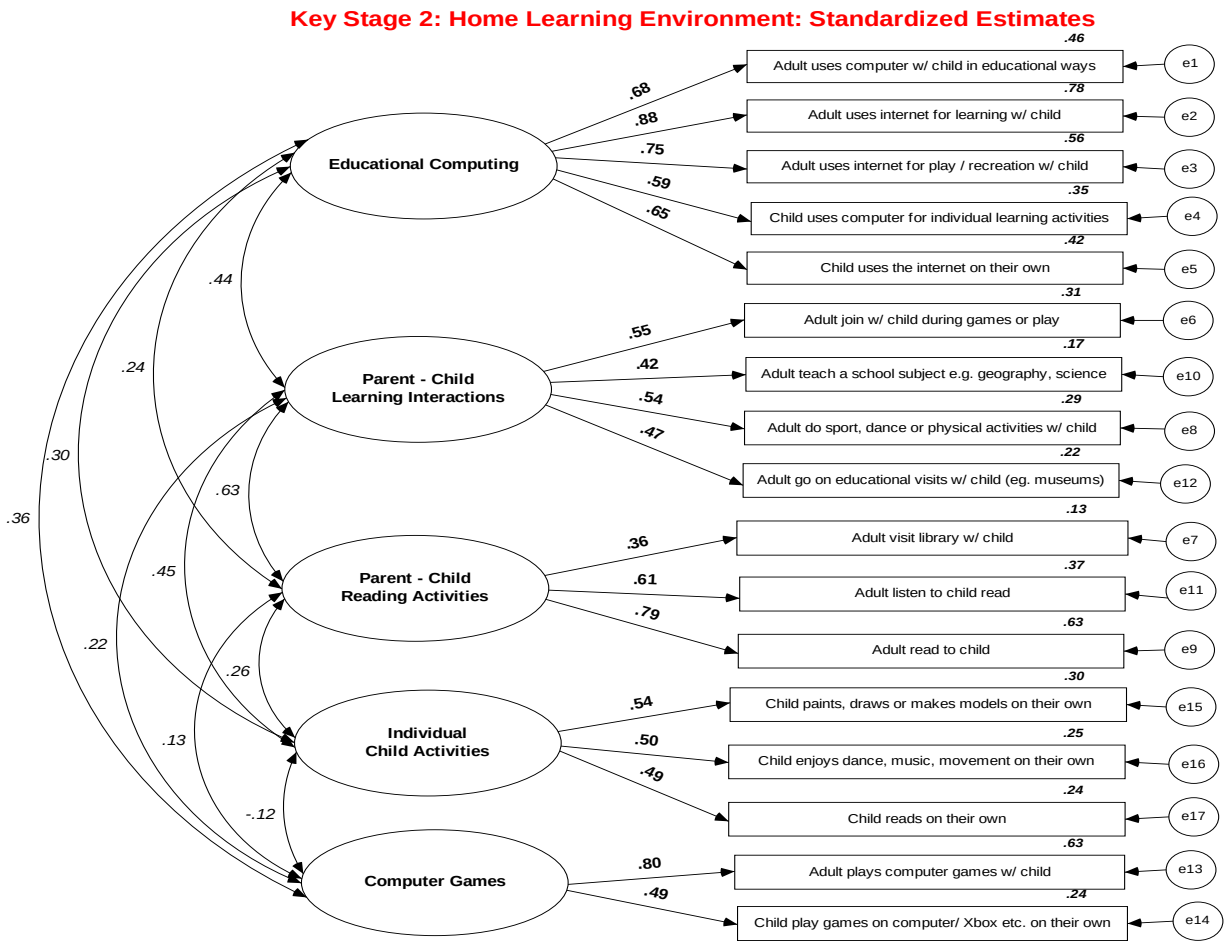
- **Parent-child one-to-one interactions at home**
  - Respondent plays with the child using toys/games/puzzles.
  - Respondent reads to the child.
  - Respondent listens to the child read.

- **Expressive play**
  - The Child plays 'make believe' or pretend games.
  - The Child paints/draws/makes models.

- The Child enjoys dance music and movement.

The Key Stage 2 Home Learning Environment (HLE)

KS2 HLE Factors and the items loading on these factor:



Appendix 6: Results of Contextualised Multilevel Analyses

Table A.6.1: Contextualised Models for English Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2463**				**2996**			
Number of schools	**533**				**799**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.01	0.19	*	0.02	0.01	0.19	*
Gender (compared to boys)	0.37	0.04	0.46	*	0.35	0.04	0.41	*
Birth weight (compared to normal)								
Very Low Weight	-0.30	0.14	-0.37	*	-0.46	0.15	-0.53	*
Low Birth Weight	0.00	0.07	0.00		-0.05	0.07	-0.06	
Missing	0.11	0.15	0.14					
Ethnic groups (compared to White UK Heritage)								
White European	-0.05	0.10	-0.06		-0.11	0.09	-0.13	
Black Caribbean	0.02	0.10	0.02		-0.06	0.10	-0.07	
Black African	0.02	0.13	0.03		0.04	0.14	0.04	
Other Ethnic Minority	0.06	0.12	0.07		-0.04	0.13	-0.05	
Indian	0.19	0.13	0.23		0.13	0.14	0.15	
Pakistani	0.11	0.11	0.14		0.08	0.11	0.09	
Bangladeshi	0.29	0.19	0.35		0.26	0.19	0.30	
Mixed Heritage	-0.05	0.08	-0.06		-0.08	0.08	-0.10	
Early Developmental Problems (compared to none)								
1+ Developmental Problem	-0.17	0.05	-0.21	*	-0.19	0.06	-0.22	*
Missing	0.27	0.93	0.33					
Early Behavioural Problems (compared to none)								
1 + Behavioural Problem	-0.15	0.05	-0.18	*	-0.17	0.06	-0.20	*
Number of Siblings (compared to none)								
1 sibling	0.02	0.05	0.03		0.04	0.05	0.05	
2 siblings	-0.09	0.05	-0.10		-0.05	0.06	-0.06	
3 or more siblings	-0.25	0.06	-0.31	*	-0.22	0.06	-0.25	*
Missing	0.30	0.35	0.36					
Mother's Age	0.10	0.03	0.16	*	0.08	0.03	0.12	*
FSM in Year 9 (compared to none)								
Eligible for FSM	-0.25	0.05	-0.30	*	-0.26	0.05	-0.30	*
Missing	0.05	0.18	0.06					
Family Salary (compared to 'no salary')								
2,500 – 15,000	0.02	0.06	0.03		0.04	0.06	0.04	
17,500 – 27,500	0.09	0.06	0.11		0.12	0.07	0.14	
30,000 – 37,000	0.09	0.07	0.11		0.13	0.07	0.15	
37,500– 66,000	0.17	0.07	0.20	*	0.19	0.08	0.22	*
+67,500	0.33	0.12	0.40	*	0.26	0.12	0.30	*
Missing	0.12	0.06	0.15	*				
Family Socio Economic Status (compared to the Highest)								
Other professional non manual	-0.05	0.08	-0.07		-0.06	0.08	-0.07	
Skilled non manual	-0.10	0.09	-0.12		-0.14	0.09	-0.17	
Skilled manual	-0.24	0.10	-0.29	*	-0.26	0.10	-0.30	*
Semi skilled	-0.19	0.10	-0.23		-0.25	0.11	-0.29	*
Unskilled	-0.18	0.14	-0.22		-0.26	0.15	-0.31	
Unemployed: not working	-0.01	0.14	-0.02		-0.04	0.15	-0.05	
Missing	-0.31	0.31	-0.38					
Mother's Qualification (compared to none)								
Vocational	0.14	0.06	0.17	*	0.13	0.07	0.15	
Academic age 16	0.18	0.05	0.22	*	0.15	0.05	0.18	*
Academic age 18	0.28	0.08	0.34	*	0.26	0.08	0.30	*
Degree or Higher Degree	0.50	0.08	0.61	*	0.43	0.08	0.49	*
Other professional / Miscellaneous	0.41	0.15	0.50	*	0.30	0.16	0.35	*

Missing	0.13	0.17	0.16					
Father's Qualification (compared to none)								
Vocational	0.06	0.07	0.07		0.04	0.08	0.05	
Academic age 16	0.07	0.06	0.08		0.07	0.05	0.08	
Academic age 18	0.18	0.08	0.21	*	0.12	0.09	0.13	
Degree or Higher Degree	0.29	0.08	0.36	*	0.24	0.09	0.27	*
Other professional / Miscellaneous	0.27	0.18	0.33		0.22	0.17	0.25	
Absent Father	-0.002	0.06	0.00					
Missing	-0.79	0.35	-0.96	*				
Early Years HLE (compared to 0 – 13)								
14 – 19	0.02	0.07	0.03		0.08	0.07	0.09	
20 – 24	0.03	0.07	0.04		0.08	0.07	0.09	
25 – 32	0.15	0.07	0.19	*	0.20	0.07	0.24	*
33 – 45	0.24	0.08	0.29	*	0.31	0.09	0.36	*
Missing	0.04	0.13	0.05					
KS1 HLE Enrichment Outings (compared to low)								
Medium KS1 HLE	0.14	0.05	0.17	*	0.10	0.06	0.11	
High KS1 HLE	0.19	0.08	0.24	*	0.16	0.08	0.19	*
KS2 HLE Educational Computing (compared to low)								
Medium KS2 HLE	0.16	0.04	0.19	*	0.13	0.06	0.15	*
High KS2 HLE	0.10	0.07	0.12		0.07	0.08	0.08	
FSM school level	-0.01	0.00	-0.19	*	-0.01	0.00	-0.18	*
% White British	-0.003	0.001	-0.20	*	-0.003	0.001	-0.15	*
Intercept	4.67	0.13			4.60	0.14		
Log restricted-likelihood	-3165.27							
Random Effects								
School variance	0.06		0.01		0.09			
Residual variance	0.68		0.02		0.75			
Intra-school correlation (ICC)	0.0765				0.1126			
Null model								
School variance	0.28		0.04		0.31			
Residual variance	0.89		0.03		0.89			
Intra-school correlation (ICC)	0.2397				0.2588			
% Reduction school variance	80%				70%			
% Reduction pupil variance	24%				16%			
% Reduction total variance	38%				30%			

Table A.6.2: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

	Year 9 Mathematics TA Original Data				Year 9 Mathematics TA Imputed Data STATA ICE			
Number of pupils	2500				2996			
Number of schools	536				799			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.01	0.15	*	0.02	0.01	0.15	*
Gender (compared to boys)	-0.06	0.05	-0.05		-0.02	0.05	-0.02	
Birth weight (compared to normal)								
Very Low Weight	-0.46	0.20	-0.40	*	-0.69	0.20	-0.59	*
Low Birth Weight	-0.10	0.09	-0.09		-0.14	0.10	-0.12	
Missing	0.29	0.20	0.25					
Ethnic groups (compared to White UK Heritage)								
White European	-0.06	0.14	-0.05		-0.09	0.13	-0.08	
Black Caribbean	0.02	0.14	0.02		-0.07	0.14	-0.06	
Black African	-0.15	0.18	-0.13		-0.09	0.18	-0.08	
Other Ethnic Minority	0.32	0.17	0.28	*	0.22	0.17	0.18	
Indian	0.42	0.18	0.37	*	0.38	0.17	0.32	*
Pakistani	0.14	0.15	0.12		0.15	0.15	0.13	
Bangladeshi	0.45	0.26	0.40		0.49	0.25	0.42	*
Mixed Heritage	-0.07	0.11	-0.06		-0.06	0.10	-0.05	
Early Developmental Problems (compared to none)								
1+ Developmental Problem	-0.19	0.07	-0.16	*	-0.24	0.07	-0.21	*
Missing	1.04	0.66	0.91					
Early Behavioural Problems (compared to none)								
1 + Behavioural Problem	-0.21	0.07	-0.18	*	-0.26	0.07	-0.22	*
Number of Siblings (compared to none)								
1 sibling	0.05	0.07	0.05		0.07	0.06	0.06	
2 siblings	0.00	0.07	0.00		0.02	0.07	0.01	
3 or more siblings	-0.22	0.08	-0.19	*	-0.16	0.08	-0.14	*
Missing	-0.63	0.43	-0.55					
FSM in Year 9 (compared to none)								
Eligible for FSM	-0.35	0.07	-0.31	*	-0.37	0.07	-0.31	*
Missing	-0.26	0.24	-0.23					
Family Salary (compared to 'no salary')								
2,500 – 15,000	0.005	0.08	0.004		0.04	0.08	0.03	
17,500 – 27,500	0.20	0.09	0.18	*	0.20	0.08	0.17	*
30,000 – 37,000	0.13	0.10	0.11		0.16	0.10	0.13	
37,500– 66,000	0.25	0.10	0.21	*	0.25	0.10	0.21	*
+67,500	0.18	0.16	0.16		0.19	0.15	0.16	
Missing	-0.03	0.08	-0.03					
Family Socio Economic Status (compared to the Highest)								
Other professional non manual	-0.03	0.12	-0.03		-0.15	0.11	-0.13	
Skilled non manual	-0.21	0.13	-0.18		-0.36	0.12	-0.31	*
Skilled manual	-0.38	0.14	-0.33	*	-0.51	0.13	-0.43	*
Semi skilled	-0.38	0.14	-0.33	*	-0.56	0.14	-0.48	*
Unskilled	-0.41	0.19	-0.36	*	-0.62	0.20	-0.53	*
Unemployed: not working	0.17	0.20	0.15		-0.14	0.19	-0.12	
Missing	-0.64	0.37	-0.56					
Mother's Qualification (compared to none)								
Vocational	0.07	0.09	0.06		0.08	0.09	0.07	
Academic age 16	0.21	0.07	0.18	*	0.20	0.08	0.17	*
Academic age 18	0.37	0.11	0.32	*	0.39	0.11	0.33	*
Degree or Higher Degree	0.58	0.11	0.50	*	0.57	0.11	0.48	*
Other professional / Miscellaneous	0.45	0.21	0.39	*	0.45	0.21	0.38	*
Missing	0.14	0.20	0.12					
Father's Qualification (compared to none)	0.18	0.09	0.16	*	0.09	0.10	0.08	

Vocational								
Academic age 16	0.13	0.08	0.11		0.08	0.08	0.07	
Academic age 18	0.20	0.11	0.17		0.15	0.12	0.13	
Degree or Higher Degree	0.42	0.11	0.37	*	0.23	0.12	0.20	*
Other professional / Miscellaneous	0.24	0.24	0.21		0.09	0.23	0.08	
Absent Father	0.02	0.08	0.02					
Missing	-0.94	0.43	-0.82	*				
Early Years HLE (compared to 0 – 13)								
14 – 19	0.11	0.09	0.10		0.17	0.09	0.15	
20 – 24	0.13	0.10	0.11		0.16	0.10	0.13	
25 – 32	0.28	0.10	0.25	*	0.33	0.10	0.28	*
33 – 45	0.44	0.12	0.38	*	0.50	0.11	0.42	*
Missing	0.23	0.18	0.20					
KS2 HLE Educational Computing (compared to low)								
Medium KS2 HLE	0.19	0.05	0.17	*	0.19	0.08	0.17	*
High KS2 HLE	0.14	0.09	0.12		0.12	0.11	0.10	
FSM school level	-0.01	0.00	-0.20	*	-0.01	0.00	-0.17	*
% White British	-0.004	0.002	-0.15	*	-0.002	0.002	-0.08	
Intercept	5.34	0.18			5.33	0.19		
Log restricted-likelihood	-3995.95							
Random Effects								
School variance	0.06		0.02		0.09			
Residual variance	1.32		0.04		1.38			
Intra-school correlation (ICC)	0.0444				0.0601			
Null model								
School variance	0.36		0.06		0.42			
Residual variance	1.58		0.05		1.56			
Intra-school correlation (ICC)	0.1887				0.2103			
% Reduction school variance	83%				79%			
% Reduction pupil variance	17%				11%			
% Reduction total variance	29%				26%			

Table A.6.3: Contextualised Models for Science Teacher Assessment Levels in Year 9 (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	2465				2996			
Number of schools	534				799			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.01	0.16	*	0.02	0.01	0.15	*
Gender (compared to boys)	0.03	0.04	0.03		0.04	0.04	0.05	
Birth weight (compared to normal)								
Very Low Weight	-0.30	0.16	-0.33		-0.46	0.16	-0.48	*
Low Birth Weight	0.02	0.08	0.02		-0.05	0.07	-0.06	
Missing	0.25	0.16	0.28					
Ethnic groups (compared to White UK Heritage)								
White European	0.16	0.11	0.18		0.09	0.11	0.09	
Black Caribbean	-0.10	0.11	-0.11		-0.16	0.11	-0.17	
Black African	-0.13	0.14	-0.14		-0.08	0.15	-0.08	
Other Ethnic Minority	0.25	0.13	0.28		0.24	0.13	0.25	
Indian	0.27	0.14	0.30	*	0.21	0.14	0.22	
Pakistani	0.10	0.12	0.11		0.08	0.11	0.09	
Bangladeshi	0.32	0.21	0.36		0.35	0.22	0.36	
Mixed Heritage	-0.04	0.09	-0.04		-0.09	0.09	-0.09	
Early Developmental Problems (compared to none)								
1+ Developmental Problem	-0.14	0.06	-0.15	*	-0.20	0.06	-0.21	*
Missing	-0.19	1.02	-0.21					
Mother's Age	0.06	0.03	0.09	*	0.05	0.03	0.07	
FSM in Year 9 (compared to none)								
Eligible for FSM	-0.29	0.06	-0.31	*	-0.28	0.06	-0.29	*
Missing	-0.13	0.20	-0.15					
Family Salary (compared to 'no salary')								
2,500 – 15,000	-0.03	0.07	-0.03		-0.03	0.06	-0.03	
17,500 – 27,500	0.09	0.07	0.10		0.08	0.07	0.09	
30,000 – 37,000	0.00	0.08	0.00		0.06	0.08	0.06	
37,500– 66,000	0.11	0.08	0.12		0.12	0.08	0.13	
+67,500	0.19	0.12	0.21		0.11	0.10	0.12	
Missing	0.04	0.07	0.04					
Family Socio Economic Status (compared to the Highest)								
Other professional non manual	-0.07	0.09	-0.08		-0.09	0.11	-0.10	
Skilled non manual	-0.20	0.10	-0.23	*	-0.26	0.12	-0.28	*
Skilled manual	-0.32	0.11	-0.35	*	-0.37	0.12	-0.39	*
Semi skilled	-0.28	0.11	-0.31	*	-0.38	0.13	-0.40	*
Unskilled	-0.28	0.15	-0.30		-0.39	0.17	-0.41	*
Unemployed: not working	-0.08	0.16	-0.09		-0.14	0.16	-0.14	
Missing	-0.60	0.34	-0.66					
Mother's Qualification (compared to none)								
Vocational	0.23	0.07	0.25	*	0.23	0.08	0.24	*
Academic age 16	0.26	0.06	0.29	*	0.22	0.06	0.24	*
Academic age 18	0.44	0.09	0.49	*	0.43	0.10	0.45	*
Degree or Higher Degree	0.56	0.09	0.61	*	0.50	0.09	0.53	*
Other professional / Miscellaneous	0.53	0.17	0.59	*	0.47	0.17	0.49	*
Missing	0.26	0.18	0.29					
Father's Qualification (compared to none)								
Vocational	0.18	0.07	0.20	*	0.09	0.07	0.10	
Academic age 16	0.20	0.06	0.22	*	0.13	0.06	0.13	*
Academic age 18	0.27	0.09	0.29	*	0.17	0.08	0.18	*
Degree or Higher Degree	0.44	0.09	0.48	*	0.25	0.10	0.26	*
Other professional / Miscellaneous	0.17	0.19	0.19		0.05	0.20	0.05	
Absent Father	0.11	0.06	0.13					
Missing	-0.56	0.38	-0.62					

Early Years HLE (compared to 0 – 13)								
14 – 19	0.03	0.07	0.03		0.04	0.08	0.04	
20 – 24	0.12	0.08	0.13		0.10	0.08	0.10	
25 – 32	0.20	0.08	0.22	*	0.19	0.08	0.20	*
33 – 45	0.37	0.09	0.41	*	0.34	0.10	0.36	*
Missing	0.03	0.15	0.03					
KS1 HLE Enrichment Outings (compared to low)								
Medium KS1 HLE	0.14	0.05	0.15	*	0.09	0.07	0.09	
High KS1 HLE	0.11	0.08	0.12		0.10	0.09	0.10	
KS2 HLE Individual Activities (compared to low)								
Medium KS2 HLE	0.16	0.04	0.17	*	0.14	0.07	0.15	*
High KS2 HLE	0.02	0.07	0.02		0.09	0.08	0.10	
FSM school level	-0.01	0.00	-0.22	*	-0.01	0.00	-0.20	*
% White British	-0.003	0.001	-0.18	*	-0.002	0.001	-0.10	
Intercept	4.81	0.14			4.88	0.16		
Log restricted-likelihood	-3375.14							
Random Effects								
School variance	0.04		0.01		0.06			
Residual variance	0.83		0.03		0.91			
Intra-school correlation (ICC)	0.0408				0.0621			
Null model								
School variance	0.30		0.04		0.30			
Residual variance	0.99		0.03		1.00			
Intra-school correlation (ICC)	0.2366				0.2330			
% Reduction school variance	89%				80%			
% Reduction pupil variance	16%				9%			
% Reduction total variance	33%				26%			

Table A.6.4: Contextualised Models for Science Teacher Assessment Levels in Year 9 WITHOUT FSM (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	2465				2996			
Number of schools	534				799			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Age	0.02	0.01	0.16	*	0.02	0.01	0.15	*
Gender (compared to boys)	0.03	0.04	0.04		0.05	0.04	0.05	
Birth weight (compared to normal)								
Very Low Weight	-0.32	0.16	-0.35	*	-0.47	0.16	-0.49	*
Low Birth Weight	-0.01	0.08	-0.01		-0.07	0.08	-0.08	
Missing	0.24	0.17	0.27					
Ethnic groups (compared to White UK Heritage)								
White European	0.14	0.11	0.15		0.07	0.11	0.07	
Black Caribbean	-0.08	0.11	-0.08		-0.16	0.11	-0.16	
Black African	-0.13	0.14	-0.15		-0.09	0.15	-0.09	
Other Ethnic Minority	0.22	0.13	0.24		0.21	0.13	0.22	
Indian	0.28	0.14	0.30	*	0.21	0.14	0.22	
Pakistani	0.14	0.12	0.15		0.11	0.11	0.12	
Bangladeshi	0.29	0.21	0.32		0.33	0.22	0.34	
Mixed Heritage	-0.03	0.09	-0.03		-0.09	0.09	-0.10	
Early Developmental Problems (compared to none)								
1+ Developmental Problem	-0.13	0.06	-0.15	*	-0.20	0.06	-0.21	*
Missing	-0.31	1.03	-0.34					
Mother's Age	0.07	0.03	0.10	*	0.05	0.03	0.07	
Family Salary (compared to 'no salary')								
2,500 – 15,000	0.03	0.06	0.03		0.02	0.06	0.02	
17,500 – 27,500	0.16	0.07	0.17	*	0.15	0.07	0.15	*
30,000 – 37,000	0.08	0.08	0.09		0.13	0.08	0.13	
37,500– 66,000	0.18	0.08	0.19	*	0.19	0.07	0.20	*
+67,500	0.26	0.12	0.29	*	0.17	0.10	0.18	
Missing	0.08	0.07	0.09					
Family Socio Economic Status (compared to the Highest)								
Other professional non manual	-0.07	0.09	-0.08		-0.09	0.11	-0.10	
Skilled non manual	-0.21	0.10	-0.23	*	-0.27	0.12	-0.28	*
Skilled manual	-0.34	0.11	-0.37	*	-0.38	0.12	-0.40	*
Semi skilled	-0.30	0.11	-0.32	*	-0.38	0.13	-0.40	*
Unskilled	-0.34	0.15	-0.37	*	-0.45	0.17	-0.47	*
Unemployed: not working	-0.13	0.16	-0.14		-0.19	0.16	-0.19	
Missing	-0.63	0.35	-0.69					
Mother's Qualification (compared to none)								
Vocational	0.26	0.07	0.28	*	0.25	0.08	0.26	*
Academic age 16	0.29	0.06	0.32	*	0.25	0.06	0.26	*
Academic age 18	0.47	0.09	0.52	*	0.46	0.10	0.48	*
Degree or Higher Degree	0.59	0.09	0.65	*	0.54	0.09	0.56	*
Other professional / Miscellaneous	0.56	0.17	0.62	*	0.50	0.17	0.52	*
Missing	0.28	0.18	0.31					
Father's Qualification (compared to none)								
Vocational	0.17	0.07	0.18	*	0.09	0.07	0.09	
Academic age 16	0.19	0.06	0.21	*	0.12	0.06	0.12	*
Academic age 18	0.26	0.09	0.28	*	0.17	0.09	0.17	*
Degree or Higher Degree	0.41	0.09	0.45	*	0.24	0.10	0.25	*
Other professional / Miscellaneous	0.16	0.19	0.18		0.05	0.21	0.05	
Absent Father	0.09	0.06	0.10					
Missing	-0.58	0.39	-0.63					
Early Years HLE (compared to 0 – 13)								
14 – 19	0.03	0.07	0.03		0.04	0.08	0.04	
20 – 24	0.12	0.08	0.13		0.10	0.08	0.11	
25 – 32	0.20	0.08	0.22	*	0.19	0.08	0.20	*

33 – 45	0.39	0.09	0.42	*	0.35	0.10	0.37	*
Missing	-0.01	0.15	-0.01					
KS1 HLE Enrichment Outings (compared to low)								
Medium KS1 HLE	0.15	0.05	0.16	*	0.10	0.07	0.10	
High KS1 HLE	0.12	0.08	0.13		0.11	0.09	0.11	
KS2 HLE Individual Activities (compared to low)								
Medium KS2 HLE	0.16	0.04	0.17	*	0.14	0.07	0.15	*
High KS2 HLE	0.02	0.07	0.02		0.10	0.09	0.10	
FSM school level	-0.01	0.00	-0.28	*	-0.01	0.00	-0.24	*
% White British	-0.003	0.001	-0.17	*	-0.002	0.001	-0.09	
Intercept	4.69	0.14			4.76	0.16		
Log restricted-likelihood	-3385.46							
Random Effects								
School variance	0.03		0.01		0.06			
Residual variance	0.84		0.03		0.92			
Intra-school correlation (ICC)	0.0388				0.0604			
Null model								
School variance	0.30		0.04		0.30			
Residual variance	0.99		0.03		1.00			
Intra-school correlation (ICC)	0.2366				0.2330			
% Reduction school variance	89%				81%			
% Reduction pupil variance	15%				8%			
% Reduction total variance	33%				25%			

Appendix 7: The Combined Impact of Pre-School Experience and Secondary School Academic Effectiveness

Table A.7.1: Contextualised Models for English Teacher Assessment Levels in Year 9: Pre-school Quality (ECERS-E) by Secondary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	**2478**				**2655**			
Number of schools	**542**				**579**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Quality by Secondary School Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Quality, Low Effectiveness	0.37	0.21	0.44		0.39	0.21	0.45	
Medium Pre-school Quality, Low Effectiveness	0.38	0.18	0.45	*	0.41	0.17	0.48	*
High Pre-school Quality, Low Effectiveness	0.36	0.19	0.43		0.43	0.18	0.51	*
No pre-school, Medium Effectiveness	0.35	0.18	0.42		0.43	0.17	0.50	*
Low Pre-school Quality, Medium Effectiveness	0.42	0.17	0.50	*	0.43	0.17	0.51	*
Medium Pre-school Quality, Medium Effectiveness	0.47	0.17	0.56	*	0.50	0.16	0.59	*
High Pre-school Quality, Medium Effectiveness	0.46	0.17	0.55	*	0.48	0.16	0.57	*
No pre-school, High Effectiveness	0.29	0.22	0.34		0.27	0.22	0.32	
Low Pre-school Quality, High Effectiveness	0.28	0.21	0.33		0.33	0.21	0.39	
Medium Pre-school Quality, High Effectiveness	0.25	0.19	0.30		0.27	0.18	0.31	
High Pre-school Quality, High Effectiveness	0.37	0.20	0.44		0.40	0.19	0.47	*
% Reduction school variance	69%				73%			
% Reduction pupils variance	21%				18%			
% Reduction total variance	33%				32%			

* p <0.05

Figure A.7.1: The Combined Impact of Pre-school Quality (ECERS-E) and Secondary School Academic Effectiveness on English Teacher Assessment Levels in Year 9

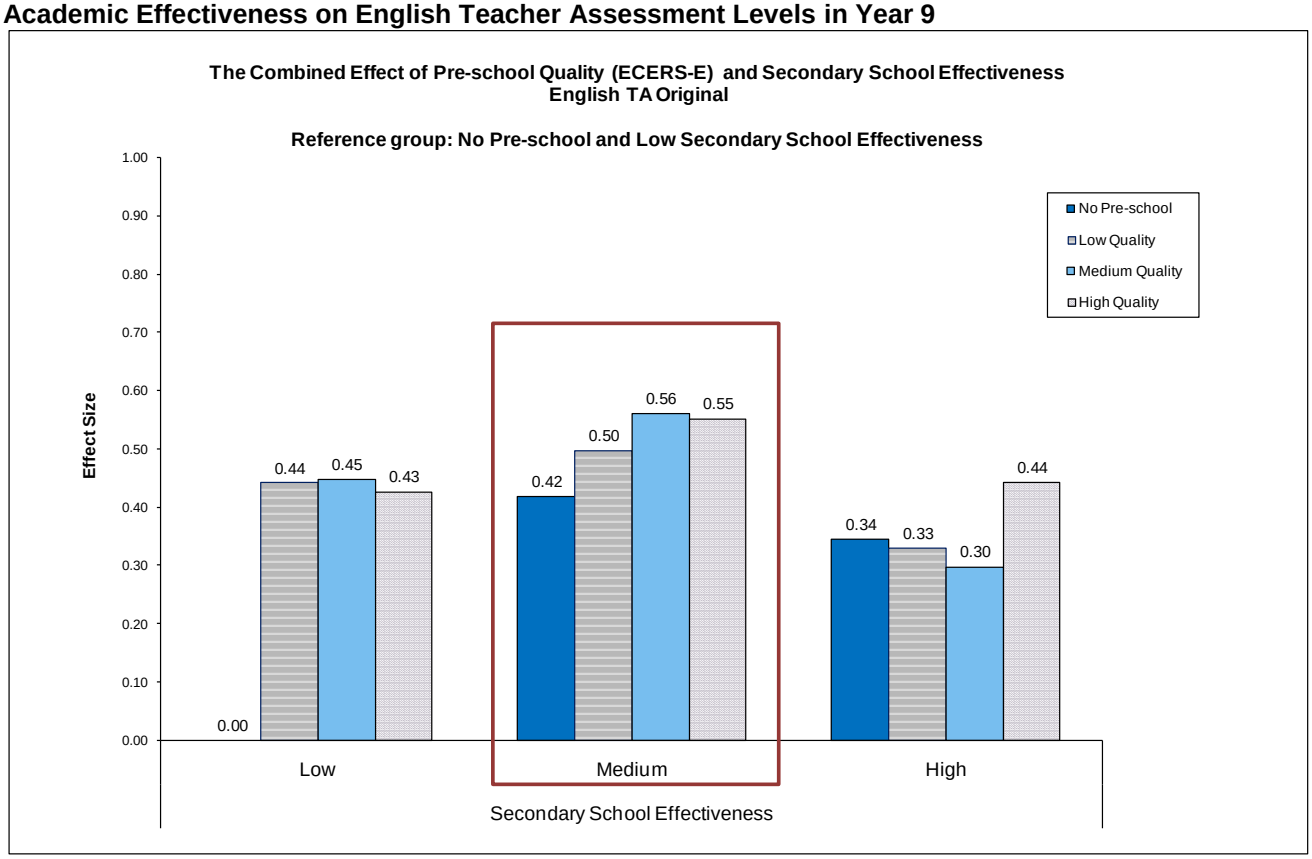


Table A.7.2: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Quality (ECERS-E) by Secondary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	**2517**				**2655**			
Number of schools	**545**				**579**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Quality by Secondary School Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Quality, Low Effectiveness	0.73	0.28	0.63	*	0.64	0.27	0.54	*
Medium Pre-school Quality, Low Effectiveness	0.42	0.23	0.36		0.36	0.22	0.30	
High Pre-school Quality, Low Effectiveness	0.49	0.25	0.42	*	0.44	0.24	0.38	
No pre-school, Medium Effectiveness	0.27	0.24	0.23		0.21	0.23	0.18	
Low Pre-school Quality, Medium Effectiveness	0.51	0.23	0.44	*	0.46	0.22	0.40	*
Medium Pre-school Quality, Medium Effectiveness	0.62	0.22	0.53	*	0.58	0.21	0.50	*
High Pre-school Quality, Medium Effectiveness	0.62	0.22	0.54	*	0.58	0.22	0.50	*
No pre-school, High Effectiveness	0.35	0.29	0.30		0.32	0.28	0.27	
Low Pre-school Quality, High Effectiveness	0.39	0.28	0.34		0.39	0.28	0.33	
Medium Pre-school Quality, High Effectiveness	0.35	0.24	0.31		0.30	0.23	0.25	
High Pre-school Quality, High Effectiveness	0.35	0.26	0.30		0.33	0.26	0.28	
% Reduction school variance	75%				77%			
% Reduction pupils variance	15%				12%			
% Reduction total variance	26%				26%			

* p <0.05

Figure A.7.2: The Combined Impact of Pre-school Quality (ECERS-E) and Secondary School Academic Effectiveness on Mathematics Teacher Assessment Levels in Year 9

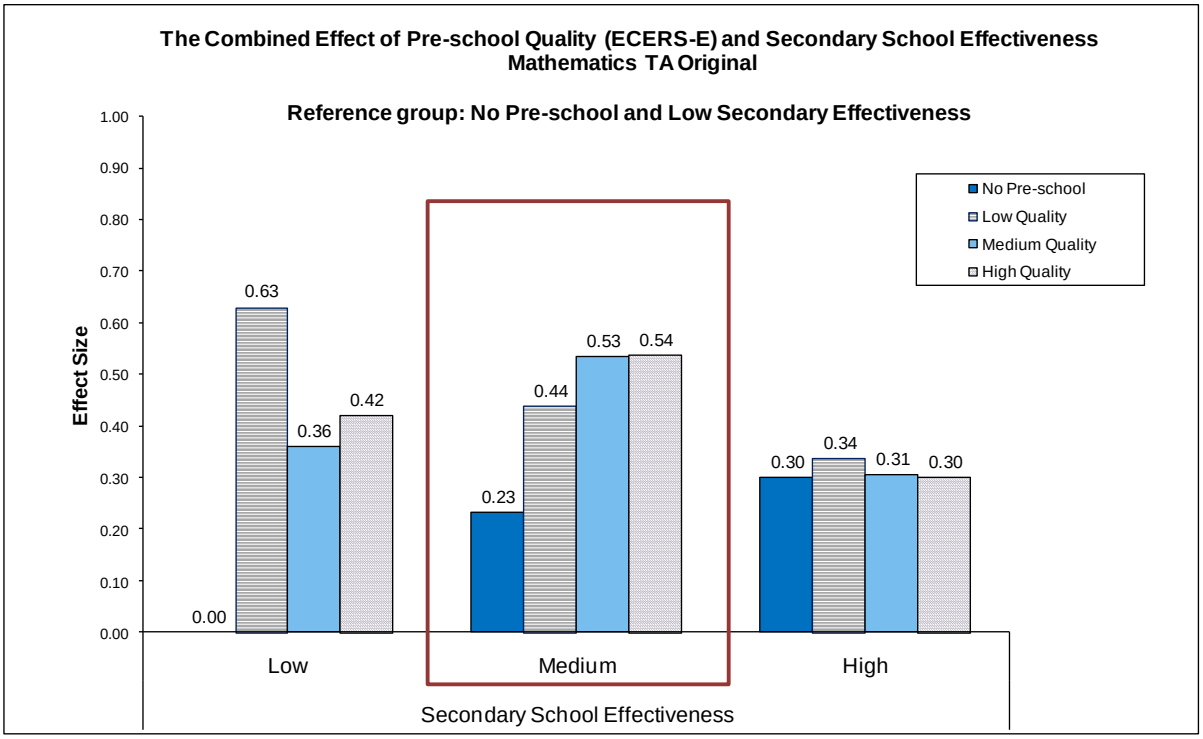


Table A.7.3: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Quality (ECERS-E) by Secondary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	2480				2655			
Number of schools	543				579			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Quality by Secondary School Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Quality, Low Effectiveness	0.72	0.22	0.78	*	0.69	0.22	0.74	*
Medium Pre-school Quality, Low Effectiveness	0.42	0.18	0.45	*	0.44	0.19	0.46	*
High Pre-school Quality, Low Effectiveness	0.52	0.20	0.56	*	0.55	0.20	0.59	*
No pre-school, Medium Effectiveness	0.32	0.19	0.35		0.37	0.19	0.39	*
Low Pre-school Quality, Medium Effectiveness	0.42	0.18	0.46	*	0.46	0.18	0.49	*
Medium Pre-school Quality, Medium Effectiveness	0.55	0.17	0.59	*	0.60	0.17	0.64	*
High Pre-school Quality, Medium Effectiveness	0.50	0.18	0.54	*	0.55	0.18	0.58	*
No pre-school, High Effectiveness	0.36	0.22	0.38		0.42	0.22	0.44	
Low Pre-school Quality, High Effectiveness	0.37	0.22	0.40		0.42	0.22	0.45	*
Medium Pre-school Quality, High Effectiveness	0.16	0.19	0.17		0.20	0.19	0.21	
High Pre-school Quality, High Effectiveness	0.39	0.21	0.42		0.42	0.20	0.45	*
% Reduction school variance	84%				85%			
% Reduction pupils variance	13%				11%			
% Reduction total variance	30%				29%			

* p <0.05

Figure A.7.3: The Combined Impact of Pre-school Quality (ECERS-E) and Secondary School Academic Effectiveness on Science Teacher Assessment Levels in Year 9

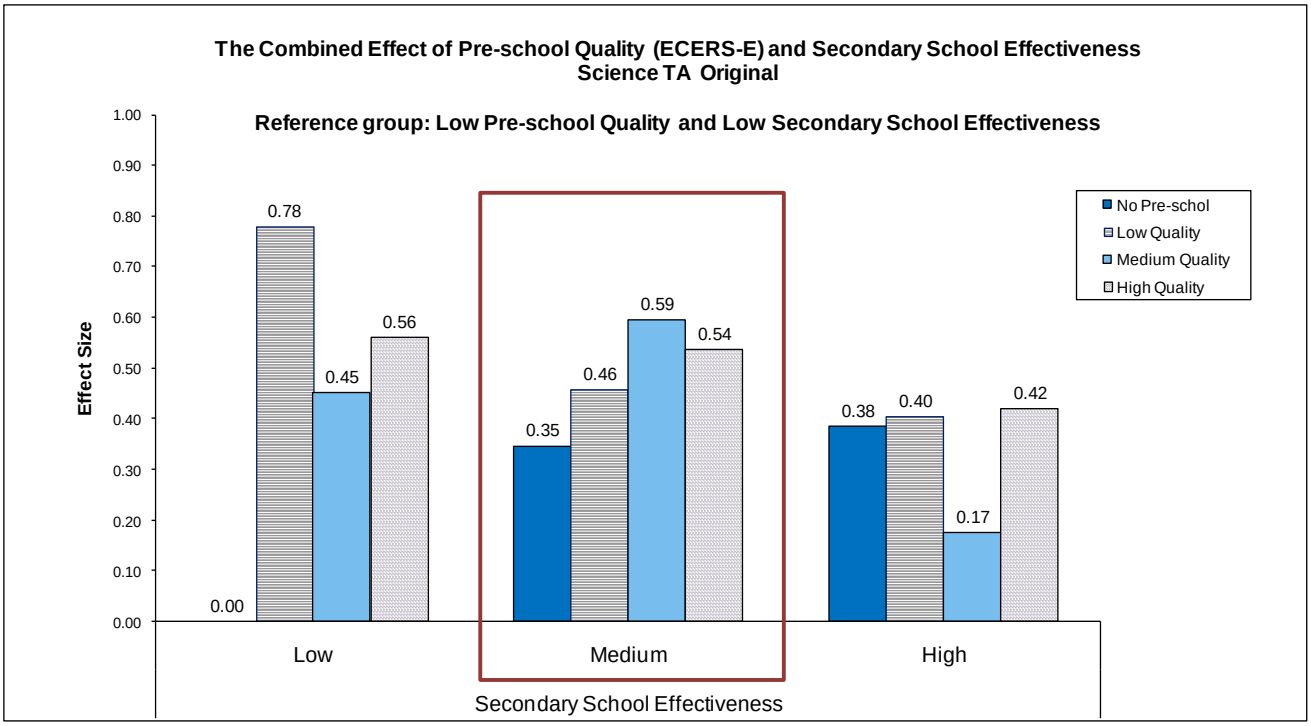


Table A.7.4: Contextualised Models for English Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Pre-reading) by Secondary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 English TA Original Data				Year 9 English TA Imputed Data STATA ICE			
Number of pupils	2478				2655			
Number of schools	542				579			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness by Secondary School Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Effectiveness, Low Effectiveness	0.24	0.21	0.29		0.34	0.21	0.40	
Medium Pre-school Effectiveness, Low Effectiveness	0.39	0.18	0.46	*	0.40	0.17	0.47	*
High Pre-school Effectiveness, Low Effectiveness	0.45	0.20	0.54	*	0.50	0.19	0.59	*
No pre-school, Medium Effectiveness	0.35	0.18	0.42		0.42	0.17	0.49	*
Low Pre-school Effectiveness, Medium Effectiveness	0.39	0.17	0.47	*	0.41	0.17	0.48	*
Medium Pre-school Effectiveness, Medium Effectiveness	0.49	0.17	0.58	*	0.50	0.16	0.59	*
High Pre-school Effectiveness, Medium Effectiveness	0.50	0.17	0.60	*	0.52	0.16	0.61	*
No pre-school, High Effectiveness	0.30	0.22	0.36		0.28	0.22	0.33	
Low Pre-school Effectiveness, High Effectiveness	0.32	0.21	0.38		0.33	0.20	0.39	
Medium Pre-school Effectiveness, High Effectiveness	0.30	0.19	0.36		0.31	0.18	0.36	
High Pre-school Effectiveness, High Effectiveness	0.29	0.21	0.34		0.34	0.20	0.39	
% Reduction school variance	68%				73%			
% Reduction pupils variance	21%				18%			
% Reduction total variance	33%				32%			

* p <0.05

Figure A.7.4: The Combined Impact of Pre-school Effectiveness (Pre-reading) and Secondary School Academic Effectiveness on English Teacher Assessment Levels in Year 9

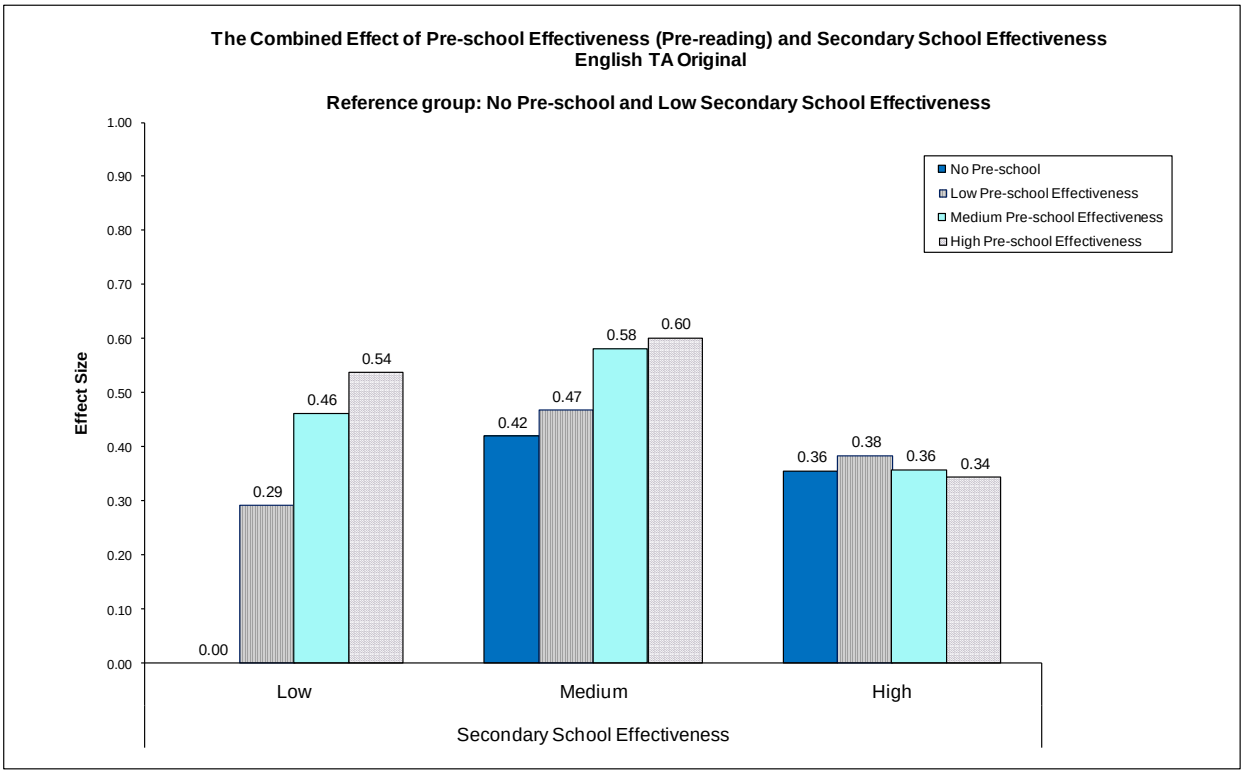


Table A.7.5: Contextualised Models for Mathematics Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Early Number Concepts) by Secondary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Maths TA Original Data				Year 9 Maths TA Imputed Data STATA ICE			
Number of pupils	2517				2655			
Number of schools	545				579			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness by Secondary School Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Effectiveness, Low Effectiveness	0.35	0.42	0.30		0.11	0.39	0.10	
Medium Pre-school Effectiveness, Low Effectiveness	0.44	0.23	0.38		0.39	0.22	0.33	
High Pre-school Effectiveness, Low Effectiveness	0.66	0.26	0.57	*	0.61	0.25	0.53	*
No pre-school, Medium Effectiveness	0.27	0.24	0.23		0.22	0.23	0.18	
Low Pre-school Effectiveness, Medium Effectiveness	0.57	0.23	0.49	*	0.53	0.22	0.46	*
Medium Pre-school Effectiveness, Medium Effectiveness	0.57	0.22	0.50	*	0.53	0.21	0.46	*
High Pre-school Effectiveness, Medium Effectiveness	0.73	0.23	0.63	*	0.70	0.22	0.60	*
No pre-school, High Effectiveness	0.34	0.29	0.30		0.31	0.28	0.27	
Low Pre-school Effectiveness, High Effectiveness	0.64	0.28	0.56	*	0.60	0.27	0.52	*
Medium Pre-school Effectiveness, High Effectiveness	0.32	0.24	0.27		0.29	0.23	0.24	
High Pre-school Effectiveness, High Effectiveness	0.25	0.28	0.21		0.19	0.27	0.16	
% Reduction school variance	74%				76%			
% Reduction pupils variance	16%				12%			
% Reduction total variance	27%				26%			

Figure A.7.5: The Combined Impact of Pre-school Effectiveness (Early Number Concepts) and Secondary School Academic Effectiveness on Mathematics Teacher Assessment Levels in Year 9

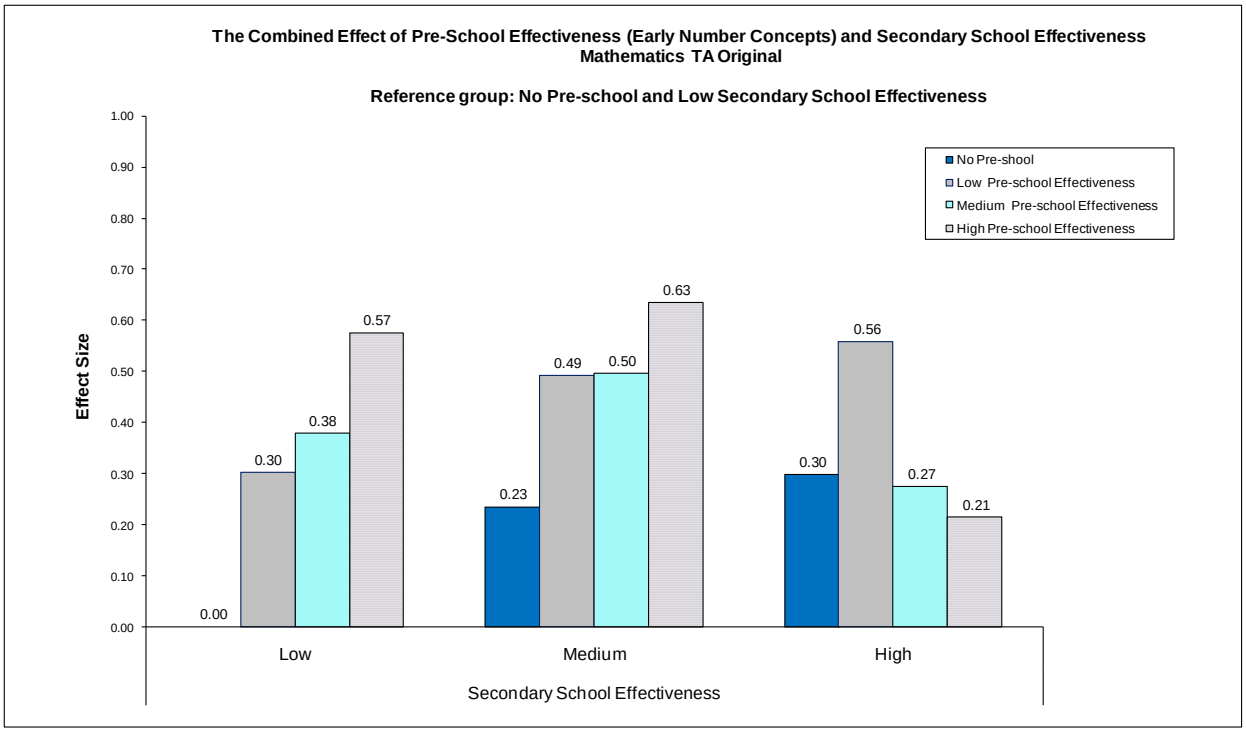
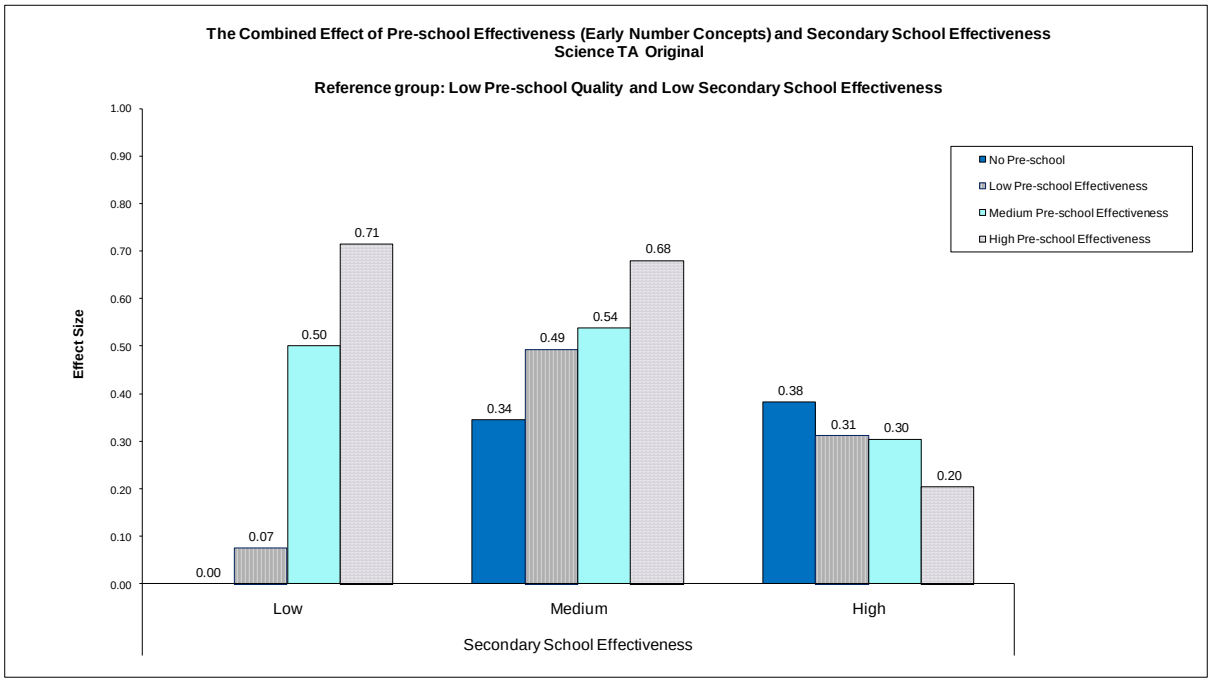


Table A.7.6: Contextualised Models for Science Teacher Assessment Levels in Year 9: Pre-school Effectiveness (Early Number Concepts) by Secondary School Academic Effectiveness Combined Term (Original Data vs. Imputed Data)

	Year 9 Science TA Original Data				Year 9 Science TA Imputed Data STATA ICE			
Number of pupils	**2480**				**2655**			
Number of schools	**543**				**579**			
Fixed Effects	**Coef**	**SE**	**ES**	**Sig**	**Coef**	**SE**	**ES**	**Sig**
Pre-school Effectiveness by Secondary School Effectiveness (compared to No Pre-school and Low Effectiveness)								
Low Pre-school Effectiveness, Low Effectiveness	0.07	0.33	0.07		0.00	0.32	0.00	
Medium Pre-school Effectiveness, Low Effectiveness	0.46	0.18	0.50	*	0.49	0.18	0.52	*
High Pre-school Effectiveness, Low Effectiveness	0.66	0.20	0.71	*	0.68	0.20	0.72	*
No pre-school, Medium Effectiveness	0.32	0.19	0.34		0.37	0.19	0.40	*
Low Pre-school Effectiveness, Medium Effectiveness	0.46	0.18	0.49	*	0.49	0.18	0.52	*
Medium Pre-school Effectiveness, Medium Effectiveness	0.50	0.17	0.54	*	0.55	0.17	0.58	*
High Pre-school Effectiveness, Medium Effectiveness	0.63	0.18	0.68	*	0.68	0.18	0.73	*
No pre-school, High Effectiveness	0.35	0.22	0.38		0.42	0.22	0.45	
Low Pre-school Effectiveness, High Effectiveness	0.29	0.22	0.31		0.34	0.22	0.36	
Medium Pre-school Effectiveness, High Effectiveness	0.28	0.19	0.30		0.33	0.18	0.35	
High Pre-school Effectiveness, High Effectiveness	0.19	0.22	0.20		0.21	0.22	0.23	
% Reduction school variance	83%				84%			
% Reduction pupils variance	14%				12%			
% Reduction total variance	30%				29%			

* p <0.05

Figure A.7.6: The Combined Impact of Pre-school Effectiveness (Early Number Concepts) and Secondary School Academic Effectiveness on Science Teacher Assessment Levels in Year 9



Appendix 8: Details of Factor Composition- Schools and Teaching Processes and Pupils' Views of Themselves

Table A.8.1: The Final Factor Structure Views of School

Teacher support ***Cronbachs =0.86***	**School environment** ***Cronbachs =0.75***
Most teachers mark and return my homework promptly	My school has attractive buildings
Most teachers make helpful comments on my work	Classrooms are nicely decorated and clean
Teachers praise me when I work hard	Toilets are well cared for and clean
Teachers tell me how to make my work better	My school is well organised
Teachers make me feel confident about my work	People think my school is a good school
Teachers are available to talk to me privately	
Teachers will help me if I ask for help	
I get rewarded for good behaviour	
Headteacher qualities ***Cronbachs =0.72***	**Behaviour climate** ***Cronbachs=0.72***
I often see the headteacher around the school	Most pupils want to leave this school as soon as they can
The headteacher makes sure pupils behave well	Pupils who work hard are given a hard time by others
The headteacher is interested in how much we learn	Most pupils take no notice of school rules
	There are often fights (in or around school)
	Some kids bring knives or weapons into school
Teacher behavioural management ***Cronbachs =0.62***	**Learning resources** ***Cronbachs=0.70***
Teachers make sure that it is quiet during lessons	There are enough computers
Teachers make clear how I should behave	Science labs are good
Teachers take action when rules are broken	We have a good library
Teachers are not bothered if pupils turn up late	We get enough time using computers in subject lessons
Valuing pupils ***Cronbachs=0.78***	**Emphasis on learning** ***Cronbachs=0.68***
The school values pupils' views	Most pupils want to do well in exams
Teachers listen to what pupils say about the school	Teachers expect me to do my best
The teachers in this school show respect for all pupils	The lessons are usually 'challenging' but 'do-able'
Teachers are unpleasant if I make mistakes	Most teachers want me to understand something, not just memorise it
Teachers are friendly towards me	Most teachers believe that mistakes are OK so long as we learn

Table A.8.2: The Final Factor Structure for Views of Self

Maths academic self image ***Cronbachs =0.91***	**English academic self image** ***Cronbachs =0.90***
I learn things quickly in my Maths classes	I learn things quickly in my English classes
I have always done well in my Maths classes	I have always done well in my English classes
Compared to others my age I am good at Maths	Compared to others my age I am good at English
Work in my Maths classes is easy for me	Work in my English classes is easy for me
I get good marks in Maths	I get good marks in English
Values ***Cronbachs=0.75***	**Popularity** ***Cronbachs =0.83***
Making sure strong people don't pick on weak people	I make friends easily
Respecting rules and laws	Other teenagers want me to be their friend
Controlling your temper even when you feel angry	I have more friends than most other teenagers my age
Respecting other peoples points of view	Most other teenagers like me
Sorting out disagreements without fighting	I am popular with other pupils in my pupils in my age group
Anxiety ***Cronbachs=0.78***	**Enjoyment of school** ***Cronbachs=0.74***
In class I worry about what the others think of me	My school is a friendly place
I get a lot of headaches, stomach aches or sickness	On the whole I like being at school
I worry a lot	I like to answer questions in class
I am often unhappy, downhearted or tearful	School is a waste of time for me
I am nervous in new situations	I like most of the lessons
I have many fears, I am easily scared	I am bored in lessons

Appendix 9: Tested Ofsted Inspection Judgments

Several Ofsted inspection judgments were tested as measures of secondary school quality in multilevel models that controlled for background and family measures:

- How effective, efficient and inclusive is the provision of education, integrated care and any extended services in meeting the needs of learners?
- How well does the school work in partnership with others to promote learners' well-being?
- The effectiveness of the school's self-evaluation.
- The capacity to make any necessary improvements.
- Effective steps have been taken to promote improvement since the last inspection?
- How well do learners achieve?
- The standards reached by learners.
- How well learners make progress, taking account of any significant variations between groups of learners?
- How well learners with learning difficulties and disabilities make progress?
- The extent of learners' spiritual, moral, social and cultural development.
- The behaviour of learners.
- The attendance of learners.
- How well learners enjoy their education?
- The extent to which learners adopt safe practices.
- The extent to which learners adopt healthy lifestyles.
- The extent to which learners make a positive contribution to the community.
- How well learners develop workplace and other skills that will contribute to their future economic well-being?
- How good is the overall personal development and well-being of the learners?
- How effective are teaching and learning in meeting the full range of learners' needs?
- How well do the curriculum and other activities meet the range of needs and interests of learners?
- How well are learners cared for, guided and supported?

Appendix 10: Implications of the Abolition of National Tests at KS3 and the Strategy of Using Multiple Imputation for the Analysis of EPPSE Pupils' Cognitive Outcomes in Year 9

10.1 Abolition of KS3 Tests

The Key Stage 3 National Assessment NPD dataset provides valuable measures of academic outcomes for pupils who are part of the EPPSE study. It has enabled analyses of both attainment and progress to be conducted in comparison to earlier KS data (KS1 and KS2). However, earlier analyses at KS1 and KS2 used test scores data rather than rely solely on TA levels[33].

In October 2008, it was announced that the requirement for schools to carry out KS3 tests would cease. Teacher Assessment would still be a requirement for pupils and test papers would still be available for schools to use, but here was no obligation on schools to conduct the tests or to report on results if there were undertaken.

This posed a challenge for the EPPSE team. KS3 test data was only available for the first two of the four EPPSE cohorts (a potential loss of 57% (N=1599) of the data on our main cognitive outcomes).

Options for analysis of KS3 Attainment data

The options for analysis following abolition of the tests were:

a) Use National Assessment test data for the analysis of cognitive outcomes in Year 9, either i) just using actual scores for cohorts 1 and 2 where available or ii) using all four cohorts but reporting results based on the imputation of the large missing set of test data;

b) Use Teacher Assessment (TA) data as outcomes for all four cohorts, which covered around 90% (N=2643 out of 2812[34]) of the EPPSE sample. This would involve presenting results on TA outcomes where the number of cases that required TA levels to be imputed was much lower than for test scores.

Following analysis of these options we decided to use Teacher Assessment for our main outcome measures.

Undertaking analysis using KS3 National Assessment test scores, but only for cohorts 1 and 2 would have produced potentially misleading results. Cohorts 3 and 4 are somewhat different in composition to cohorts 1 and 2 (for example, they have a higher proportion of pupils who had attended better quality pre-schools, have more disadvantaged children and include most of the children who had not attended pre-school at all – the home group).

It would have been possible to use multiple imputation for the missing KS3 National Assessment test scores based on prior outcomes and other data. However, as some test data were missing for cohorts 1 and 2 and all data were missing for cohorts 3 and 4 this would have resulted in imputed scores being used for more EPPSE pupils than the number of pupils who had valid KS3 test data.

[33] Although we have analysed raw differences in results using TA levels and test scores for younger ages in KS1 and KS2 (Sammons et al., 2011c)

[34] This represents the 'active sample'. However, in this report we used a slightly larger sample – the 'original sample' – (N=3002). Please see section 10.2.2 for details on obtaining this sample. The percentage of the TA data available for this sample was 86% (2574 out of 3002)

This was not considered to be the most appropriate option given the availability of valid TA levels for larger number of pupils in KS3 and the fact that using test scores with substantial amount of imputed data could be seen as less reliable.

Teacher Assessment data, on the other hand, were available for all four cohorts, with less than 15% missing. Imputing the missing data was considered to be the best option and would be less likely to see challenges to the analysis on methodological grounds. This decision was taken despite acknowledging some disadvantages in using teacher assessment (rather than test) data. Teacher assessment *levels* are not as highly differentiated as actual KS *point scores* and therefore offer much less sensitivity to variations in the effect of factors of interest. Teacher assessment data have also been found to increase the apparent achievement gap at age 14 for gender and for some measures of social disadvantage (possibly reflecting bias or perceptual influences on the professional judgements of teachers – see Sammons et al., 2009). The recent report by Lord Bew on the use of TA at KS2 has given attention to some of the problems of unreliability and bias in TA levels (Bew, 2011).

We considered that it was necessary to use all four cohorts in the KS3 analysis as this ensured that the pre-school experiences and the experiences of children from disadvantaged backgrounds were included in the analyses.

This technical report shows the results of the analyses based only on the original data (i.e., no missing data were imputed) and compared these to the resulted equivalent analyses based on the imputed datasets. It should be noted that the imputed results reported focus only on TA outcomes not the test scores.

10.2. The multiple imputation of background factors

The technical procedure for multiple imputation of missing data was conducted *simultaneously* for **all** variables (**background** and **outcome** measures) (see 10.2.2 for more details).

This approach to dealing with missing background data is increasingly advocated in major longitudinal studies (Little & Rubin, 1987; Rubin, 1987). It enhances the rigour and confidence which can be placed in results by maximising sample size, an important issue in longitudinal research, where sample attrition increases over time.

Overall, based on multiple testing and comparisons, we are confident that analyses conducted on the multiple imputation dataset led to very similar patterns of results to the ones obtained on the original data.

10.2.1 Testing of multiple imputation models

We evaluated different multiple imputation models, then applied the most robust to the EPPSE data.

As a first step (and as an internal exercise) we tested the technical performances of various multiple imputation procedures in relation to an original complete-case dataset. On the complete-case dataset, we randomly deleted values and imputed these deleted values using the following software and packages:

- STATA: contributed package *ICE*
- STATA: *MI* impute
- R: Package *MICE*
- R: Package *mi*
- R: Package *Amelia II*

- SAS: Standard *PROC MI* Procedure

The same growth curve model was tested on the original complete-case dataset and on the datasets created after multiple imputation. The estimates, standard errors and random-effects parameters obtained on the original complete-case dataset and the various resulting datasets were compared. Additionally, diagnostic plots that assessed the convergence of the imputation models were inspected. Comparing the results on imputed data with the results on a complete-case dataset was an important strategy to check how close the imputed values were to the 'real' values where these were already known.

Based on these comparisons and inspections, we concluded that the closest results to the original complete-case dataset were obtained on the datasets that were multiple imputed with the ICE (STATA) and Amelia II (R) procedures.

Following this decision, the original datasets were imputed using these two alternative approaches and more comparisons were conducted. This time, comparisons were made on the results of the multilevel models relevant to the EPPSE cognitive and social behavioural outcomes. For the cognitive outcomes, the school variance, residual variance and the intra-school correlation (ICC) obtained on the dataset imputed with ICE (STATA) were found to be somewhat closer to the same parameters obtained on the original data than the parameters obtained on the dataset imputed with Amelia II (R).

After consideration of the various results, the ICE procedure was selected for the multiple imputations to be used in the analyses of pupils' KS3 cognitive outcomes and the results focused on the TA outcomes.

10.2.2 The multiple imputation strategy

We started with the original sample (N=3172) and selected only the cases for pupils who had cognitive outcomes for both English and mathematics for three or more time points. For Year 9, having either a test score or a TA was considered a valid data point. In addition, cases were only included if they did not have missing data on more than five out of a larger set of pupil and family background variables. The final sample size included N=3002 pupils.

The multiple imputation procedure replaces missing values for the specified variables with a set of possible values (where the number of values equals the number of the imputations). The missing values for any variable are predicted using existing values from other variables. Thus, if we specify 10 imputations, each missing value will be replaced by 10 possible values and the results reported are based on the average of the estimates across these sets of analyses on the 10 imputed datasets. This provides greater stability and reliability of findings.

The following variables were entered in the imputation model: birth weight, number of siblings, behavioural, developmental and health problems, mother's and father's qualification level, family SES, family salary, mother's and father's age, mother's and father's employment, marital status, Early Years HLE, KS1and KS2 HLE factors, cognitive outcomes from baseline to Year 9 (test scores but for KS2 and KS3 also TA levels), neighbourhood safety, Year 6 and Year 9 FSM, and Year 9 SEN. The exact percentages of missing data on each of the relevant variables are shown in Tables 1.5 and 1.6 from Section 1. They range from 1.3% to 25.5%.

In addition, items from the "All about me" and "All about me in school" questionnaires were also included into the imputation model (i.e., revision classes for SATs, time spent on homework, time spent on watching TV/DVDs/Videos, time spent on household work, etc.). Finally, we included in the imputation model the factor scores related to teaching and school processes (i.e., 'emphasis on learning', 'behaviour climate', 'teacher discipline' etc.), and also pupils' self-perceptions ('academic self-concept', 'enjoyment of school', 'anxiety').

As noted earlier, the multiple imputation procedure imputes data simultaneously for **all** the specified variables in the imputation model (thus, for example, background characteristics and cognitive outcomes are imputed at the same time), creating 10 stacked datasets that have complete data for the imputed variables.

The multilevel models were tested on all 10 datasets (as STATA has the capacity to recognise a multiple imputed dataset) and the results were combined following Rubin's rule and presented as an overall model.

10.2.3 Comparison of Original and Imputed data

This technical report provides tables of results throughout providing the details of both the original (N=3002 with the level of missing data being variable: 14% for TA levels, 25.5% for father's qualification etc.) and the imputed datasets (N=3002 which is the pooled sample of the 10 imputed data sets with no missing values for the variables listed above). The results are broadly consistent across both sets of analysis in terms of size and direction of association which provides confidence in the findings.

Multiple imputation is not a perfect procedure and moreover, because of the non-random nature of the missing data in the original dataset (a problem in nearly all social and educational research as data are very rarely missing at random), we expected that in some cases the estimates would differ. This would most likely be for variables with high levels of missing values and/or where missing values reflected special characteristics (e.g. where father's qualification or family SES data is missing because the father was absent from the family from an early age rather than present but not providing data).

When exploring the differences between results obtained on the original data and imputed data, the focus was on the size of the absolute difference rather than on the statistical significance. The cut off point for the size of this difference in the effect sizes (ES_{orig}-ES_{imp}) was chosen to be 0.15. Thus, in the cases where the pattern of effect sizes was broadly similar and the differences within the cut off point, the slight differences in statistical significance were not given an undue weight (since any choice of significance level is, to some extent, arbitrary). Differences in the statistical significance between the original and imputed data could be due to the sample size (the effect size not significant on the original data but reaches significance on the (larger) imputed dataset) or to the way the missing data are (re)distributed in the imputation model (this is probably the case for the variables with large proportions of missing values and where missing values are not missing at random).

The differences in effect sizes (in absolute terms) obtained in the contextualised models on the original and imputed data sets varied from 0 to 0.35. Considering the simple contextualised (CM) and the value added contextualised models (CVAM), we identified the following variables for which the differences in effect sizes between the two data sets were higher than 0.15: birth weight, family SES, salary, father's qualification, Year 6 test scores and ethnicity. However, these were exceptions that did not affect the robustness of the overall results. They make very little difference to the overall model as it can be seen from the comparisons of model statistics such as total variance accounted for and relevant SE for different predictors. In the case of larger differences (0.17-0.22) for the father's qualification measure, the imputed results are likely to be more stable. This could be because of the inclusion of pupils with absent father into the missing category (i.e., whose qualifications were not known) that can be, however, robustly imputed from other known measures (e.g., mother's qualification, income, family SES etc.).

In the contextualised and value added models that also tested the impact of secondary school quality (measured by Ofsted judgments related to the 'quality of pupil's learning' and 'attendance of learners') on the cognitive attainment, some of the effect sizes for the 'missing' category on the two

data sets were either in opposite direction (although none of them significant) or the differences between them were higher than 0.15 (see Table A.10.1 and Table A.10.2 below). The 'missing' category for both data sets was retained as we deemed it inappropriate to impute missing data for the Ofsted secondary school measures because, unlike pupils' measures, there were fewer variables that might help predict Ofsted results (this missing category would include private schools but also others that had not been inspected within the relevant time frame).

Table A.10.1: Contextualised Models: Selected Differences in ES between Original and Imputed Data Above the 0.15 Cut Off

Background Variables					
Year 9 English TA levels		Year 9 Maths TA levels		Year 9 Science TA levels	
Variable	Difference $\|ES_{orig}-ES_{imp}\|$	Variable	Difference $\|ES_{orig}-ES_{imp}\|$	Variable	Difference $\|ES_{orig}-ES_{imp}\|$
Birth weight-Very low (ref. Normal)	0.16*	Birth weight-Very low (ref. Normal)	0.19*		
		Family SES-Unskilled (ref. Highest)	0.17*		
		Father's Qualification-Degree (ref. None)	0.17*	Father's Qualification-Degree (ref. None)	0.22*
Secondary School Variables					
Attendance of Learners-Missing (ref. Inadequate)	0.35†	Attendance of Learners-Missing (ref. Inadequate)	0.24*	Attendance of Learners-Missing (ref. Inadequate)	0.29†
		Quality of Pupil's Learning-Missing (ref. Inadequate)	0.27†		

*ES significant on both the original and imputed data
†ES significant on original data only

Table A.10.2: Contextualised Value Added Models: Selected Differences in ES between Original and Imputed Data Above the 0.15 Cut Off

Background Variables					
Year 9 English TA levels		Year 9 Maths TA levels		Year 9 Science TA levels	
Variable	Difference $\|ES_{orig}-ES_{imp}\|$	Variable	Difference $\|ES_{orig}-ES_{imp}\|$	Variable	Difference $\|ES_{orig}-ES_{imp}\|$
Salary->67500 (ref. No Salary)	0.28†	Year 6 Test Scores^	0.20*	Father's Qualification - Academic Age 18 (ref. None)	0.20†
		Ethnicity-Bangladeshi (ref. White UK)	0.26*	Father's Qualification-Degree (ref. None)	0.22*
Secondary School Variables					
Attendance of Learners (ref.	0.30†	Attendance of Learners (ref.	0. 33†		

Inadequate)		Inadequate)			
		Quality of Pupil's Learning (ref. Inadequate)	0.33†		

*ES significant on both the original and imputed data
†ES significant on original data only
^Note that the ES for prior Maths Scores is very large (2.99 vs. 2.79) in both analyses and this difference is relatively modest

Summary
A limitation of the present study is the fact that our analyses that predicted TA levels as the outcome (dependent variable) do not allow us to address potential bias in TA judgments regarding different pupil groups. However, these were explored in a previous report where we compared TA levels to test scores for cohorts 1 and 2 (Sammons et al., 2009).

All social science and educational research is affected by the problem of missing data. The use of valid cases ignores or masks the problem, but also entails the potential for bias because data is very rarely missing at random. In our EPPSE analyses, we have sought to identify and address the issue of missing data explicitly to increase the rigor of the research and the findings.

Overall, based on multiple testing and comparisons, we are confident that analyses conducted on the multiple imputation dataset led to very similar patterns of results to the ones obtained on the original data. By presenting the results based on both sets of data, it is possible to show how the patterns of results are consistent across both sets of analyses. This enabled us to capitalise on the larger sample size in the imputed data that enhances our ability to identify statistically significant effects for the predictors.

Glossary of terms

Academic self-concept EPPSE derived two measures of Academic self-concept from Year 9 student questionnaire data:

1) 'Academic self-concept for English'
2) 'Academic self-concept for maths'

Both of the above measures are based on items taken from existing well established 'academic self-concept' scales (Marsh, 1990a; 1990b; Marsh & Hau, 2003; Marsh & Craven, 2006).

Age standardised scores Assessment scores that have been adjusted to take account of the pupil's age at testing. This enables a comparison to be made between the cognitive outcome of an individual pupil, and the relative achievement of a representative sample of pupils in the same age group throughout the country or, in this case, the relative achievement of the EPPE sample.

Anxiety A factor derived from Year 9 student questionnaire items that reflect the degree to which the students feel unhappy, worried, nervous, fearful in new situations, or suffer from minor ailments.

'at risk' The term 'at risk' is a complex one which will differ depending on the particular criteria used. For instance, the definition of possible cognitive 'at risk' status used in the ETYSEN study (see Taggart et al., 2006), based on children's cognitive attainment at entry to pre-school, was a score of one standard deviation (sd) below the mean (in standardised assessments) in relation to national norms (at risk). In the more recent EPPSE case studies, there are various definitions of risk and resilience (see Siraj-Blatchford et al., 2011).

Anti-social behaviour A social-behavioural construct identified from teachers' ratings about EPPSE students, collected through a pupil profile based on Goodman's (1997) Strength and Difficulties questionnaire. Five items formed the factor 'anti-social' behaviour e.g. Steals from home, school or elsewhere.

British Ability Scales (BAS) This is a battery of assessments specially developed by NFER-Nelson to assess very young pupils' abilities. The assessments used at entry to the EPPE study and at entry to reception were:
Block building - Visual-perceptual matching, especially in spatial orientation (only entry to study)
Naming Vocabulary – Expressive language and knowledge of names
Pattern construction – Non-verbal reasoning and spatial visualisation (only entry to reception)
Picture Similarities – Non-verbal reasoning
Early number concepts – Knowledge of, and problem solving using pre-numerical and numerical concepts (only entry to reception)
Copying – Visual–perceptual matching and fine-motor co-ordination. Used specifically for pupils without English
Verbal comprehension – Receptive language, understanding of oral instructions involving basic language concepts.

Birth weight In the EPPSE research, babies born weighing 2500 grams (5lbs 8oz) or less are defined as below normal birth weight; foetal infant classification is below 1000 grams, very low birth weight is classified as 1001-1005 grams and low birth weight is classified as 1501-2500 grams (Scott and Carran, 1989). When EPPSE uses this measure in analyses, the categories foetal infant (<1000g) and very low birth weight (1001-1005g) are often collapsed into one category due to small numbers in the former group.

Centre/School level variance The proportion of variance in a particular child/student outcome measure (i.e. Year 9 English Teacher Assessment level at the end of Key Stage 3 in secondary school) attributable to differences between individual centres/schools rather than differences between individual children/students.

Citizenship values A factor derived from Year 9 student questionnaire items that relate to how important students feel certain behaviours are such as strong people not picking on weak people,

respecting rules and laws, controlling your temper, respecting other's views, and sorting out disagreements without fighting.
Comparative Fit Index (CFI) The CFI is an index of a statistical model fit that takes into account sample size. Values close to 0.95 indicate good fit (Hu & Bentler, 1999).

Compositional effects The influence of a student's peer group on that particular student's individual outcomes.. For example, the influence of attending a school where a high percentage of students are in receipt of Free School Meals (FSM) or come from disadvantaged backgrounds. This influence is irrespective of the characteristics (FSM status) of the individual student in question. For further details see Harker (2001).

Confidence intervals (at 95 or 99%) A range of values which can be expected to include the 'true' value in 95 or 99 out of 100 samples (i.e. if the calculation was repeated using 100 random samples).

Contextualised models Cross-sectional multilevel models exploring individuals' outcomes, while controlling for individual, family and home learning environment characteristics (but not prior attainment).

Controlling for Several variables may influence an outcome and these variables may themselves be associated. Multilevel statistical analyses can calculate the influence of one variable upon an outcome having allowed for the effects of other variables. When this is done the net effect of a variable upon an outcome controlling for other variables can be established.

Correlation A correlation is a measure of statistical association that ranges from + 1 to -1.

Cronbach's alpha (α) A measurement of the internal reliability (or consistency) of the items on a test or questionnaire that ranges between 0 and 1 showing the extent to which the items are measuring the same thing (Reber, 1995). A value greater than 0.7 ($\alpha<0.7$) suggests that the items consistently reflect the construct that is being measured.

CVA (Contextualised Value Added) Measures of secondary school academic effectiveness derived from KS2-KS4 contextual value added (CVA) indicators produced by the Department for Education (DfE). At the pupil level, the CVA score was calculated as the difference between predicted attainment (i.e., the average attainment achieved by similar pupils) and real attainment in KS4. The predicted attainment was obtained by using multilevel modelling controlling for pupils' prior attainment and adjusting for their background characteristics (i.e., gender, age, ethnicity, SEN, FSM, mobility etc.). For each school, all individual pupil scores were averaged and adjusted for the proportion of pupils attending the school in a specific year. This final averaged score represents the school level CVA and it is presented as a number based around 1000 (for more technical details see http://www.education.gov.uk/performancetables/schools_08/documents.shtml).

Dispositions An overarching term used to refer to factors such as *'enjoyment of school'*, *'academic self concept (English and maths)'*, *'popularity'*, *'citizenship values'* and *'anxiety'*. The EPPSE study derived these factors from questionnaires completed by students in Year 9 called 'All about Me' and 'All about Me in school'.

ECERS-R and ECERS-E The American Early Childhood Environment Rating Scale (ECERS-R) (Harms et al., 1998) is based on child centred pedagogy and also assesses resources for indoor and outdoor play. The English rating scale (ECERS-E) (Sylva et al., 2003) was intended as a supplement to the ECERS-R and was developed specially for the EPPE study to reflect the Desirable Learning Outcomes (which have since been replaced by the Early Learning Goals, the Curriculum Guidance for the Foundation Stage, and the Early Years Foundation Stage). For more information see Sylva et al., (2010).

Educational effectiveness Research design which seeks to explore the effectiveness of educational institutions in promoting a range of child/student outcomes (often academic measures) while controlling for the influence of intake differences in child/student characteristics.

Effect sizes (ES) Effect sizes (ES) provide a measure of the strength of the relationships between different predictors and the outcomes under study. For further information see Elliot & Sammons (2004).

Emphasis on learning A factor derived from Year 9 student questionnaire items that relate to teacher expectations, emphasis on understanding something not just memorising it, teachers believing that it is okay for students to mistakes as long as they learn from them, students wanting to do well in exams, and lessons being challenging.

Enjoyment of school A factor derived from Year 9 student questionnaire items that reflect the degree to which students reported they like lessons and being at school, like answering questions in class, but also how much the student experiences boredom in lessons or feels school is a waste of time.

Factor Analysis (FA) An umbrella term covering a number of statistical procedures that are used to identify a smaller number of factors or dimensions from a larger set of independent variables or items (Reber, 1995). At KS3 EPPSE used:

- Exploratory FA – a type of analyses where no prior (theoretical) knowledge is imposed on the way the items cluster/load.
- Principal Components Analysis (PCA) – a procedure that converts a set of observations of possibly correlated items into a set of values of uncorrelated items called principal components.
- Confirmatory FA – type of factor analyses used where the measure of a factor/construct are tested against a prior (theoretical) knowledge.

Family characteristics Examples of family characteristics are mother's highest qualification level, father's highest qualification level and family socio-economic status (SES).

Free school meals (FSM) An indicator of family poverty.

General Cognitive Ability (GCA) A measure of pupils' overall cognitive ability, incorporating non-verbal and verbal BAS sub-scales.

Growth Curve Modelling "In brief, the objective of growth curve modeling1 is to describe a set of time-ordered, within-person observations using only a few parameters. For example, the intra-individual change over time, or within-person learning, that occurs with practice might be described parsimoniously by two parameters, one indicating an individual's initial level of ability (e.g., intercept), and another indicating linear rate of increase or decline in performance across multiple occasions of measurement (e.g., linear slope)....Growth curve modeling methods also allow us to describe and test hypotheses about individual differences in intra-individual change. By allowing the parameters used to describe intra-individual change to vary between individuals we can also model and examine how (and potentially why) individuals differ in their initial levels of performance (intercept), rates of improvement or decline over time (linear slope), asymptotic levels of performance, etc. Examining how the inter-individual differences in particular aspects of intra-individual change captured by each parameter relate to other inter-individual differences (e.g., covariates such as trait personality) brings us one step closer to understanding how and why individuals follow different paths of development" (Ram & Grimm, 2007; p. 303).

Headteacher qualities A factor derived from Year 9 student questionnaire items that reflect the headteacher making sure that students behave well, their presence around the school and interest in how much students learn.

Hierarchical nature of the data Data that clusters into pre-defined sub-groups or levels within a system (i.e. students, schools, local authorities).

Home learning environment (HLE) characteristics Measures derived from reports from parents (at interview or using parent questionnaires) about what children do at home (with/independent of their parents). There are several HLE measures: early years HLE, KS1 HLE, KS2 HLE (please see Appendix 4 for further details).

Hyperactivity A social-behavioural construct identified from teachers' ratings about EPPSE students, collected through a pupil profile based on Goodman's (1997) Strength and Difficulties questionnaire. Several items formed the factor 'hyperactivity' e.g. Restless, overactive, cannot stay still for long.

Income Deprivation Affecting Children Index (IDACI) The IDACI represents the percentage of children in each SOA that live in families that are income deprived. For further details see Noble et al., (2008).

Index of Multiple Deprivation (IMD) The IMD is a measure of a range of characteristics evident in a neighbourhood. For further details see Noble et al. (2004; 2008).

Internal Reliability/Consistency The degree to which the various parts of a test (items) or other instrument (e.g. questionnaire) measure the same variables/construct (Reber, 1995). An example measure would be ***Cronbach's alpha*** (see earlier).

Intra-centre/school correlation The intra-centre/school correlation measures the extent to which the outcomes from children/students in the same centre/school resemble each other as compared with those from children/students at different centres/schools. The intra-centre/school correlation provides an indication of the extent to which unexplained variance in children's/students' progress (i.e. that not accounted for by prior attainment) may be attributed to differences between centres/schools. This gives an indication of possible variation in pre-school centre/school effectiveness.

Key Stage (KS) The English education system splits students into age phases known as Key Stages as follows: KS1 (age 5-7), KS2 (8-11), KS3 (12-14), KS4 (14-16).

Mean average A measure of central tendency that is calculated by summing a set of values (or scores) and then dividing by the number of values or scores (Reber, 1995).

Multilevel modelling A methodology that allows data to be examined simultaneously at different levels within a system (i.e. children/students, pre-school centres/schools, local authorities), essentially a generalisation of multiple regression.

Multiple Disadvantage Index This measure was developed as part of the Early Years Transition & Special Educational Needs (EYTSEN) Project, which focuses on the identification of children 'at risk' of SEN (see Sammons et al., 2004d). An index was created based on 10 indicators in total: three child variables, six parent variables, and one related to the Early years Home Learning Environment (HLE).

Child variables

- First language: English as an additional language (EAL)
- Large family: 3 or more siblings
- Pre-maturity / low birth weight

Parent/HLE variables

- Mother's highest qualification level: no qualifications
- Social class of father's occupation: Semi-skilled, unskilled, never worked, absent father
- Father not employed
- Young Mother (Age 13-17 at birth of EPPE child)
- Lone parent
- Mother not working / unemployed
- Low Early years Home Learning Environment (HLE)

For further details see Sammons et al., (2002).

Multiple imputation A statistical procedure that replaces missing value with a set of predicted values (Little & Rubin, 1987). This procedure generates several imputed data sets, which are then analysed and the results combined according to Rubin's Rule (Little & Rubin, 1987).

Multiple regression A method of predicting outcome scores on the basis of the statistical relationship between observed outcome scores and one or more predictor variables.

National Assessment Levels The table below shows the levels that could be achieved by a student at different ages in their National Assessments tests / can be awarded to a student for their Teacher Assessment (TA).

Outcome	Key Stage 1 (KS1), Age 7	Key Stage 2 (KS2), Age 11	Key Stage 2 (KS3), Age 14
Reading/ English Levels	Working towards level 1 Level 1 **Level 2 – Expected Level** Level 3 Level 4	 Level 1 Level 2 Level 3 **Level 4 – Expected Level** Level 5 Level 6	 Level 1 Level 2 Level 3 Level 4 **Level 5 – Expected Level** Level 6 Level 7 Level 8
Maths Levels	Working towards level 1 Level 1 **Level 2 – Expected Level** Level 3 Level 4	 Level 1 Level 2 Level 3 **Level 4 – Expected Level** Level 5 Level 6	 Level 1 Level 2 Level 3 Level 4 **Level 5 – Expected Level** Level 6 Level 7 Level 8
Science Levels	Working towards level 1 Level 1 **Level 2 – Expected Level** Level 3 Level 4	 Level 1 Level 2 Level 3 **Level 4 – Expected Level** Level 5 Level 6	 Level 1 Level 2 Level 3 Level 4 **Level 5 – Expected Level** Level 6 Level 7 Level 8

Net effect The unique contribution of a particular variable upon an outcome while other variables are controlled.

Ofsted The Office for Standards in Education, Children's Services and Skills (Ofsted) inspect and regulate services that care for children and young people, and those providing education and skills for learners of all ages. See Matthews & Sammons (2004), and the Ofsted website (http://www.ofsted.gov.uk/content) for further details.

Pedagogical strategies Strategies used by an educator to support learning. These include the face to face interactions with students, the organisation of resources and the assessment practices.

(Poor) behaviour climate A factor derived from Year 9 student questionnaire items that relate to the general behaviour climate in the EPPSE student's school; students being given a hard time by others if they work hard, level of compliance with school rules, fighting and weapons being brought into school, and whether most students want to leave the school as soon as they can.

Popularity A factor derived from Year 9 student questionnaire items that relate to how popular students feel they are with other teenagers and how many friends they have.

Pre-reading attainment Composite formed by adding together the scores for phonological awareness (rhyme and alliteration) and letter recognition.

Pre-school effectiveness Measures of the effectiveness of pre-schools were derived from Value Added (VA) models of the sample's actual progress during pre-school, controlling for prior attainment and children's background characteristics (Sammons et al., 2004b).

Primary school effectiveness Primary school academic effectiveness scores were obtained from National Assessment data for several cohorts across all primary schools in England. Value-added scores were calculated across the years 2002-4, for each primary school in England and then extracted for schools attended by the EPPE sample (Melhuish et al., 2006a; 2006b).

Prior attainment Measures which describe a participant's achievement at the beginning of the phase or period under investigation (i.e. taken on entry to the study or school, or for Year 9 analyses, outcomes from Year 6).

Pro-social Behaviour A social-behavioural construct identified from teachers' ratings about EPPSE students, collected through a pupil profile based on Goodman's (1997) Strength and Difficulties questionnaire. Several items formed the factor 'pro-social' behaviour e.g. Considerate of other people's feelings.

Pupil Profile An instrument containing Goodman's (1997) Strength and Difficulties questionnaire plus some additional items used to collect information about EPPSE student's social behaviour. It is completed by a teacher who knows the EPPSE student well.

Quality of pre-school Measures of pre-school centre quality were collected through observational assessments (ECERS-R, ECERS-E) completed by trained researchers. For further information see ***ECERS*** and Sylva et al. (2010).

Quality of secondary schools Secondary school quality was derived from measures taken from Ofsted inspection judgments. See ***Ofsted*** for further details.

Quality of teaching Measures from Year 5 classroom observations using the IEO (Stipek) and COS-5 (Pianta) instruments. For further information see Sammons et al. (2006a; 2006b).

Root Mean Square Error of Approximation (RMSEA) The RMSEA is an index measure of model; values less than 0.06 are an indication of a good fit.

Sampling profile/procedures The EPPSE sample was constructed of:
Five regions (six Local authorities) randomly selected around the country, but being representative of urban, rural, inner city areas. Pre-schools from each of the 6 main types of target provision (nursery classes, nursery schools, local authority day nurseries, private day nurseries, play groups and integrated centres) randomly selected across the region.

School environment A factor derived from Year 9 student questionnaire items that relate to how EPPSE students view their school in terms of the physical space (the attractiveness of buildings, the decorative state of the classrooms, the condition of the toilets), as well as its reputation as a good school and how well organised it is.

School/learning resources A factor derived from Year 9 student questionnaire items that relate to practical resources for learning at the EPPSE student's school; amount of computers and getting enough time on them in lessons, and the quality of science labs and the school library.

School level variation School level variance here refers to the percentage of variation in students' outcomes that can be attributed to differences between schools.

Secondary school effectiveness Secondary school academic effectiveness scores were obtained from the Department for Education (DfE). The measure of academic effectiveness is represented by the average KS2 to KS4 contextual value added (CVA) school level scores over 4 years (2006-2009) when EPPSE students were in secondary school. See '***CVA***' as this is the same measure.

Self-regulation A social-behavioural construct identified from teachers' ratings about EPPSE students, collected through a pupil profile based on Goodman's (1997) Strength and Difficulties questionnaire. Several items formed the factor 'self-regulation' e.g. Likes to work things out for self; seeks help rarely.

Significance level Criteria for judging whether differences in scores between groups of children/students or centres/schools might have arisen by chance. The most common criteria is the 95% level ($p<0.05$), which can be expected to include the 'true' value in 95 out of 100 samples (i.e. the probability being one in twenty that a difference might have arisen by chance).

Social-behavioural development A student's ability to 'socialise' with other adults and pupils and their general behaviour to others. EPPSE uses this overarching name to refer to a range of social-behavioural outcome measures. At age 14, two of these outcomes refer to positive outcomes ('self-regulation' and 'pro-social' behaviour) and two refer to negative outcomes ('hyperactivity' and 'anti-social' behaviour).

Socio-economic status (SES) Occupational information was collected by means of a parental interview/questionnaire at different time points. The Office of Population Census and Surveys OPCS (1995) Classification of Occupations was used to classify mothers and fathers current employment into one of 8 groups: professional I, other professional non manual II, skilled non manual III, skilled manual III, semi-skilled manual IV, unskilled manual V, never worked and no response. Family SES was obtained by assigning the SES classification based on the parent with the highest occupational status.

Standard deviation (sd) A measure of the spread around the mean in a distribution of numerical scores. In a normal distribution, 68% of cases fall within one standard deviation of the mean and 95% of cases fall within two standard deviations.

Structural equation modelling (SEM) is an umbrella term for statistical modelling techniques which allow for testing causal processes and structural relationships (Byrne, 2010).

Student background characteristics Student background characteristics include age, birth weight, gender, and ethnicity.

Target centre A total of 141 pre-school centres were recruited to the EPPSE research covering 6 types of provision - ***Sampling profile/procedures***. The sample of students was drawn from these target centres.

Teacher Assessment (TA) These assessments made by teachers provide measures of students' educational outcomes for English, maths and science in Year 9 (age 14) in the form of National curriculum levels.

Teacher discipline A factor derived from Year 9 student questionnaire items that relate to the level of teacher control during lessons, in terms of behaviour, noise, rule breaking and teachers being bothered if students turn up late.

Teacher support A factor derived from Year 9 student questionnaire items that relate to support given by teachers in terms of helping students, giving them feedback, making them feel confident about their work, rewarding them for good behaviour, being available to talk privately, and marking and returning homework.

Term of birth Using EPPSE student's dates of birth, the EPPSE sample were categorised into three 'term of birth' categories: Autumn born (September to December); Spring born (January to April); Summer born (May to August).
Total BAS score By combining 4 of the BAS sub-scales (2 verbal and 2 non-verbal) a General Cognitive Ability score or Total BAS score at entry to the study can be computed. This is a measure of overall cognitive ability.

Value added models Longitudinal multilevel models exploring individuals' progress over time, controlling for prior attainment as well as significant individual, family and home learning environment characteristics.

Value added residuals (pre-school effectiveness) Differences between predicted and actual results for pre-school centres (where predicted results are calculated using value added models). See ***Pre-school effectiveness*** for further information.

Value added residuals (primary school academic effectiveness) Differences between predicted and actual results for primary schools measuring pupil progress across KS1 – KS2. For further information see ***Primary school effectiveness*** and Melhuish et al. (2006a; 2006b).

Valuing students A factor derived from Year 9 student questionnaire items that relate to whether the school values students' views, teachers listen to students views, are respectful and friendly to students, teachers are unpleasant to students if they make mistakes.

Views of school An overarching term used to refer to factors such as 'teacher support', 'school environment', 'valuing students', 'headteacher qualities', 'poor behaviour climate', 'emphasis on learning', 'teacher discipline', and 'school/learning resources'. The EPPSE study derived these factors from the questionnaire completed by students in Year 9 called 'All about me in school'.

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