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The Effective Provision of Pre-School Education [EPPE] Project

Technical Paper 8a

Measuring the Impact of Pre-School on Children's Cognitive Progress over the Pre-School Period

A longitudinal Study funded by the DfES

1997 – 2003

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Acknowledgement

The EPPE project is a major five year study funded by the DfES. The research would not be possible without the support and co-operation of the six Local Authorities (LAs) and the many pre-school centres, primary schools, children and parents participating in the research. The important contribution of the Regional Research Officers Anne Dobson, Isabella Hughes, Marjorie Jeavons, Margaret Kehoe, Katie Lewis, Maria Morahan, Sharon Sadler and our part-time Research Assistants, especially Nadine Boyne and Wesley Welcomme, has been vital to the project's completion. Helpful discussions on issues surrounding the interpretation and calculation of effect sizes were held with Professor Harvey Goldstein, Professor Peter Tymms, Dr. Steve Strand and Dr. Robert Coe. We are grateful to both the project's Steering and Consultative Committee for their helpful advice on the study.

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First Published in November 2002 by the Institute of Education University of London
20 Bedford Way, London WC1H OAL

Pursuing Excellence in Education

ISBN 085473 599 2

Printed by Formara Ltd. Southend on Sea. Essex.

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Background

The Effective Provision of Pre-school Education (EPPE) project explores the impact of pre-school centre provision on young children's cognitive progress and their social behavioural development. The EPPE study was commissioned and funded by the Department for Education and Employment (now the Department for Education and Skills). This paper reports on the main findings of the first phase of the longitudinal research which tracked a large sample of young children over the pre-school period from age 3 years plus to the start of primary school, when children entered reception classes. An educational effectiveness design was adopted which explores the developmental progress children made during this period and analyses the contribution made by different pre-school centres to cognitive and social behavioural gains.

EPPE is the first study in Europe to examine the impact on young children's developmental outcomes of individual pre-school centres, and also variations according to type of provision attended. A wide range of data about children, their parents and home environments and the pre-school settings (individual pre-school centres) they attended has been analysed. The study has explored features of pre-school centre policy and practices, including the quality of centre provision, and their relationships with children's outcomes measured at the start of primary school (usually at entry to reception class, though a few children in some areas enter primary school and are placed in year 1 classes).

The study follows children from pre-school up to age 7, the end of Key Stage 1 of primary education. It investigates the impact of a wide variety of child, parent and family factors, including amount of care outside the family, and aspects of the home learning environment provided by parents. The research seeks to establish whether different types of pre-school settings differ in their impact and effectiveness. It also seeks to identify the effects of individual centres upon young children's cognitive progress and social behavioural development. Measures of the quality of centres and details of variations in centre policy and practices have been collected from observations by trained researchers and from interviews with centre managers. The study investigates whether such factors have an impact on young children's progress and development. In total 141 target pre-school centres were drawn randomly from within each of the five regions across England included in the study. Centres were sampled from six types of provision: nursery classes, playgroups, local authority day nurseries, private day nurseries, nursery schools and integrated centres (i.e. combined centres). The research drew approximately equal numbers of target centres of each of the main type of provisions, with the exception of integrated centres which are a relatively recent innovation and of which only a small number existed at the start of the research. The five regions were chosen to cover a range of socio-economic and geographical areas including rural, metropolitan, shire county, inner-city. The regions were selected to include ethnically diverse and socio-economically disadvantaged communities.

Detailed case studies of centres, chosen because they were in the more effective half of the spectrum in terms of children's outcomes, are reported separately (see EPPE Technical Paper 10). These case studies provide rich information about processes operating in different centres. They illuminate current understanding of the ways different aspects of policy and practice, including effective early childhood pedagogical strategies, promote young children's learning and development.

This report describes the results of analyses of young children's cognitive progress during their time in pre-school. Equivalent results on social behavioural development are reported in EPPE Technical Paper 8b. Five measures of cognitive attainment assessed at entry to primary school have been studied: language attainment, two measures of non-verbal attainment, early number concepts and pre-reading attainment. A range of statistical methods has been used to analyse data for around 2800 children, representing around 95 per cent of the total child sample at entry

to the study. An additional sample of 'home' children (without pre-school centre experience) was recruited at primary school entry bringing the total to over 3100 in some analyses.

Methodology

EPPE uses statistical techniques (multilevel modelling) to measure the influence of different background factors on young children's attainments at the start of primary school. These contextualised multilevel analyses are equivalent to those conducted earlier when children entered the pre-school study (see EPPE Technical Paper 2). A comparison of the results of the analyses at the two different time points allows us to establish whether background influences change (reduce or increase) over the pre-school period. Contextualised analyses are used to identify the unique (net) contribution of particular characteristics to variation in children's outcomes, in this instance their attainments in different cognitive assessments, while other influences are controlled. Thus, for example, the impact of family socio-economic status (SES), is established while taking into account the influence of mother's qualification levels, low income (indicated by eligibility for free school meals), ethnicity, birthweight, home learning environment etc. It is of policy interest to establish the nature and strength of such background influences, individually and in total, because they are relevant to issues of equity and social inclusion.

Multilevel modelling has been used to identify and explore pre-school centre effects and the 'value added' by different centres.[1] Value added multilevel models investigate children's progress over their time in pre-school, by controlling for a child's age at assessment and prior attainment at entry to pre-school, as well as a wide range of background influences. These analyses are used to establish whether there is evidence of pre-school influences on young children's cognitive gains. In particular, the extent to which children's cognitive progress is associated with the pre-school centre attended can be calculated. The centre level variance provides an indication of the size of any effect related to pre-school attended. The calculation of residuals (based on differences between children's expected and actual attainments at primary school entry) for each centre provides a value added indicator of each centre's effectiveness in promoting progress in a given outcome (e.g. early number concepts, language etc.). Centres where children made significantly greater progress than predicted on the basis of prior attainment and intake characteristics can be viewed as *more effective* (positive outliers in value added terms). Centres where children made less progress than predicted can be viewed as *less effective* (negative outliers in value added terms).

The multilevel value added analyses are also extended to establish the extent to which factors such as type of pre-school attended, number of sessions, quality characteristics, ratios and staff qualifications show any statistical relationship with the effects of pre-school. It is thus possible to establish whether variations in quality and extent of time in pre-school have an impact on children's cognitive gains and, in particular, whether higher quality and more pre-school experience have a positive impact.

Findings concerning a sample of 'home children', who have had no pre-school centre experience before starting primary school, are reported for comparison with the pre-school sample. The contextualised multilevel analyses explore whether home children are at a disadvantage in terms of cognitive attainments when they start primary school and the extent to which any attainment gap can be attributed to the absence of pre-school experience, rather than to differences in their background characteristics. These analyses provide important evidence concerning the impact of pre-school provision.

Main Findings

[1] Cognitive progress was measured from entry to the EPPE study (age 3 years plus) until the start of primary school (usually at entry to reception classes at rising 5 years, though in some instances children are enrolled directly into year 1 classes and do not join a reception class).

The main findings of the EPPE study point to the continued strength of background influences on young children's cognitive attainments and progress and also provide new evidence concerning the impact of pre-school.

The impact of a child's background

Early findings from the EPPE research (EPPE Technical Papers 2 and 7) illustrated that there are important differences in young children's cognitive and social behavioural attainments related to specific child, parent and home environment characteristics at entry to the study (age 3 years plus). This study confirms the continued strength of such influences on cognitive outcomes measured at the start of primary education.

For certain outcomes, especially pre-reading and early number concepts, children from some ethnic minority groups, (including Black Caribbean and Black African), and children for whom English is an additional language (EAL) made greater progress during pre-school than white UK children or those for whom English is a first language. These results remain significant even when account is taken of the influence of other important factors, like mother's education level and socio-economic status (SES). Overall, such groups had significantly lower cognitive scores at entry to the study in language measures (though not in non-verbal scales). This suggests that the experience of pre-school provision may provide the opportunity for some groups to begin to 'catch up' in terms of particular areas of cognitive attainment (e.g. pre-reading skills).

The analyses have explored the extent of variation in children's attainments in school entry assessments for different groups of children. The contextualised analyses reported in Section 2 show that, while still important predictors of attainment, taken together child, parent and home environment characteristics of children account for a lower proportion of the variance in attainment at school entry for pre-reading and early number concepts measures than was the case for total cognitive ability score at entry to the pre-school study.[2] This may reflect the positive impact of pre-school experience and its ability to help reduce the inequality in cognitive development already evident at entry to pre-school. Nonetheless, such background factors remain powerfully associated with variations in young children's language attainment. One implication of this finding may be the need for more intensive work on language enrichment for young children who show poor language development at the start of pre-school. In comparison with 'home children' the analyses of attainment demonstrate a significant positive impact of pre-school for all children on all outcomes including language. This impact remains when background influences are controlled. Thus we can conclude that pre-school has an important role to play in combating disadvantage and giving children a better start at school.

Additional analyses were conducted for the sub-group of children identified as 'at risk' of special education needs (SEN), defined as those showing very low cognitive scores at entry to the study. It was found that children who are multiply disadvantaged (in terms of a range of child, family and home learning environment characteristics) show much better attainment than similarly disadvantaged children in the home sample at the start of primary school (age rising 5 years). Again this finding points to the positive impact of pre-school experience on cognitive development for particularly vulnerable groups of young children (see Early Years Transition and Special Educational Needs [EYTSEN] Technical Paper 1 for further details of the study of 'at risk' groups).

Baseline assessment of children at the start of school (usually in reception) has been required since 1998.[3] The analyses reported here show that the choice of school entry measures can have equity implications. Differences related to children's gender, EAL and ethnic background are more likely to be identified in measures of language and pre-reading skills than in non-verbal attainments. It is important that accurate measures of children's attainments at school entry are obtained covering a range of attainments so that different areas of strength/weakness can be assessed and children receive additional support, or, by contrast, sufficient challenge. A focus on

[2] Measured by the British Ability Scales (BAS) which cover both language and non-verbal skills.
[3] From September 2002 statutory assessment takes place at the end of the foundation stage.

mainly language based measures for school reception assessment may disadvantage some children of particular ethnic/language backgrounds, whereas non-verbal assessments that are less language based may provide additional information about such young children's skills. Nonetheless, it remains important not to ignore or minimise the existence of language or pre-reading differences because of their potential relationship with later attainment and progress in school. As in any assessment, it is crucial that the results of baseline assessments are used formatively to assist teachers in planning a programme to meet individual needs, rather than to influence or lower expectations for some groups.

When children's cognitive progress (measured by the change in attainment over their time in pre-school) is analysed the impact of child, parent and home environment characteristics is found to be much smaller than when variations in attainment at any one time point are explored. It must be remembered that such background characteristics showed a strong relationship with prior cognitive attainment (measured at entry to the target pre-school at age 3 years plus), and prior attainment is used as the baseline for measuring progress. Nonetheless, a number of characteristics continue to show a statistically significant influence on progress over the pre-school period, particularly for language and pre-reading. For example, girls make greater gains in pre-reading, early number concepts and non-verbal reasoning than boys over the pre-school period. Children from larger families (3+ siblings) made less progress than singletons (i.e. only children) in pre-reading and language. Children whose mothers had higher levels of educational qualifications made more progress in all outcomes. EAL children showed greater progress in pre-reading but not in language (reflecting their lower cognitive attainment at entry to pre-school especially in language). Children from higher SES families made greater progress compared to children from lower SES families in all outcomes except spatial awareness / reasoning. A range of measures of the home learning environment also show significant positive impacts on cognitive progress in pre-reading, early number and language.

These results emphasise the need to make adequate statistical control for differences in the characteristics of young children who attend different pre-school settings, in both prior attainment and other relevant characteristics, in any studies of the influence of pre-school institutions. This is important to ensure that valid comparisons can be made both at the level of individual centres and also by type of provision. It is also essential for studies seeking to compare children who do not attend a pre-school centre before they start school, because as a group they show differences in terms of a range of characteristics and, in particular, are more likely to experience multiple disadvantage.

Home learning environment

The EPPE research points to the importance of a young child's home learning environment. Although other family factors such as mother's qualification level and family SES are also highly significant, the 'Home Learning Environment' exerts a significant and independent influence on attainment at both age 3 years plus and later at the start of primary school (rising 5 years) and progress during this pre-school period. Aspects of self-reported parental involvement in activities (such as reading to their child, teaching songs and nursery rhymes, playing with letters and numbers, visiting the library, painting and drawing, emphasising the alphabet, etc) remain significant positive influences which account for differences in attainment and also influence young children's cognitive progress over the pre-school period. The study also shows that home learning environment, index (measuring the extent of different activities involving the child at home) is only moderately correlated (r=0.3) with family SES or mother's qualification levels.

These results suggest that policies for parents in disadvantaged communities which encourage active parenting strategies can help to promote young children's cognitive progress (see also the review of evidence by Sylva and MacPherson, 2002). Many pre-schools already encourage parental participation, and some have developed programmes that feature parent education. The EPPE results indicate that programmes which directly promote activities for parents and children to engage in together are likely to be most beneficial for young children (see EPPE Technical Paper 10 for discussion of such strategies in case study settings).

Variations in centre effectiveness

The value added multilevel analyses of children's progress show that the individual pre-school centre attended by a child also has an impact on cognitive progress.[4] In some centres children make significantly greater gains than in others. Centre effects are larger for pre-reading followed by early number concepts, possibly reflecting different emphases between individual settings in curriculum provision and the priority accorded to different types of activities. A number of centres were identified – some more effective in terms of child outcomes and some less effective. Just over one in 5 centres (22.0%) were found to be statistical *outliers* (performing *significantly above or significantly below* expectation for one or more cognitive area).

The typical pattern is for centres to vary somewhat in their effects on different cognitive outcomes. No centres performed significantly above or significantly below expectation for all cognitive outcomes. An important finding is that pre-school centre effects are only moderately correlated in language, early number concepts, pre-reading and non-verbal measures. This suggests that most individual pre-school settings show internal variation in effectiveness for different child outcomes. This result is in line with findings from studies of primary and secondary schools, suggesting that effectiveness is usually outcome specific. Nonetheless, the most usual profiles across the five outcomes studied show that a number of centres can be distinguished with broadly positive effects, whereas others showed generally poorer effects for most areas of cognitive progress.

Child mobility (moving from one of the target pre-school centres in the sample before starting primary school) is fairly common during the pre-school period. Over a fifth of children (23%) left their target centre before starting primary school and moved to other provision. The amount of mobility varied significantly for different types of provision, being very uncommon for those in nursery classes or nursery schools. By contrast, the majority of playgroup children (52%) had moved from their centre, often to a different form of provision, such as a nursery class. A change of centre was associated with poorer progress in pre-reading. The much higher incidence of movement from the target playgroups has implications for the analysis of the effects of this type of provision, and the effects of individual centres in particular. The high degree of mobility means that it is very difficult to measure the impact of playgroups on children's progress (either at the level of individual centres or as a type of provision) accurately. The extent of change for the playgroup sample of children, in particular, means that such children tended to experience a lower average number of sessions of pre-school attendance at the target pre-school before starting primary school, as will be discussed in the next sub-section. This was also related to poorer progress.

The impact of pre-school – quantity and quality

Taking account of other child, parent and home environment factors, children who started pre-school at a younger age (i.e. below 3 years of age) had significantly higher cognitive attainments at the start of the project (when assessed at 3 years) than those who started at an older age (over 3 years). However, the minority who started below 2 years of age did not show more positive outcomes than those who had joined their pre-school centre aged between 2 and 3 years. This cognitive advantage for those who had started at the target centre at a relatively younger age (under 3 years) was still evident when children entered primary school. It is not possible to draw firm conclusions about optimal starting age for individual children from the EPPE research. Nonetheless, this longitudinal follow up suggests that, in general, children who start pre-school at a younger age (under 3 years) experience a cognitive boost which remains evident up to the start of primary school.

Analyses also explored cognitive gains from entry to the pre-school study until start of primary school and whether this relates to duration, in terms of number of months, of pre-school

[4] Significant centre-level variance in children's cognitive progress remains, even when account is taken of prior attainment and other intake differences (in terms of child, parent and home environment characteristics).

experience. The duration of pre-school[5] showed a significant positive link with young children's cognitive progress during pre-school for all five cognitive measures. A longer period of months of pre-school experience was associated with greater gains, even when other significant factors are controlled.[6]

By contrast, the number of sessions for which a child was registered per week was not found to relate to amount of cognitive gain during pre-school, when the impact of other factors was controlled. There was no evidence that full-time provision (10 sessions per week) resulted in better outcomes than part-time provision (i.e. 5 sessions).

Taken together the findings suggest that an extended period of pre-school experience on a part time basis is likely to be more advantageous than a shorter time period of full-time provision.[7]

Quality of pre-school provision is regarded as a vital feature of early years education and care. The EPPE study explored variation in the quality of individual centres using the Early Childhood Environment Rating Scale (total ECERS-E and ECERS-R scales). Trained researchers conducted detailed observations of centres to assess quality. Higher quality as assessed by the ECERS-E scale was significantly positively related to children's cognitive progress in several areas. This instrument, developed specially for the EPPE study to reflect the Desirable Learning Outcomes (DfEE, 1996) (which were recommended goals for pre-school but have since been superseded by the Early Learning Goals (DfEE / QCA, 1999 and 2000), was positively related to children's cognitive gains in pre-reading, early number concepts and non-verbal reasoning. The *literacy* sub-scale of ECERS-E was also found to be positively related to progress in pre-reading and early number concepts, while the *diversity* sub-scale (which includes items on differentiation, observation, individual record keeping and ability grouping) was also significantly related to progress in pre-reading, early number concepts and non-verbal reasoning.

The results of analyses of the ECERS-R sub-scales also suggest that certain aspects of quality measured by this instrument (the *social interaction, adults working together* and *language reasoning* sub-scales) were associated with better progress in several cognitive outcomes. Additionally, other quality measures of adult–child interactions (the Caregiver Interaction Scale) showed effects upon development. The sub-scale *positive relationships* was related to greater pre-reading progress. By contrast, the three sub-scales which assess negative aspects of adult–child relationships and interaction (*detachment, permissive* and *punitive*) were associated with poorer progress in pre-reading and early number concepts. This indicates that children from all SES groups benefit from higher quality provision.

Quality effects were similar for both socio-economically and educationally advantaged and disadvantaged groups alike. However, a positive interaction for gender and quality suggests that boys show a greater benefit in terms of cognitive progress for early number concepts. This means that boys tend to make more progress if they attended high quality provision. Given that,

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[5] The duration of pre-school was measured by the number of months from entry assessment (age 3 plus) to the date of starting primary school. A separate measure of total number of sessions attended in the target pre-school centre during this period was also collected from registers. Analyses showed similar results but the duration measure showed a stronger relationship with progress.

[6] The baseline attainment measures were standardised on the basis of children's age at assessment, in addition age at follow up assessment in primary school was also controlled. The duration measure excludes time in pre-school prior to age at which children were recruited to the project (i.e. earlier starting age). Attendance patterns at pre-school were also found to be statistically significant

[7] Quantity of sessions attended was statistically significant. The total number of sessions a child was recorded as having attended their target pre-school centre was related to greater progress for language and verging on significance for pre-reading and spatial awareness / reasoning (pattern construction). Those who attended a higher total number of sessions during the study period made greater cognitive gains. Duration, however, showed a stronger link than attendance, when both measures were tested in the statistical models.

as a group, girls made greater cognitive gains and had higher attainments at entry to pre-school in most areas studied in this project, the positive impact of pre-school quality for boys' cognitive progress in early number is of special interest. It suggests that raising the quality of pre-school provision may help promote boys' attainment levels. This may be particularly important since it was found that on average the home learning environment scores of boys were somewhat lower than those of girls, suggesting possible gender differences in parenting practices.

Type of provision

Several significant differences between the six types of provision in their effects on progress over the pre-school period were identified, after controlling for other factors. Type of provision was not significantly related to attainment at entry to pre-school, when account was taken of differences in intake in terms of child, parent and home environment characteristics (EPPE Technical Paper 2). The findings suggest that differences in children's cognitive progress related to type of provision emerged during the pre-school period.

In analysing type of provision effects, the multilevel analyses controlled for differences in duration of pre-school, as well as child mobility (change of centre), since these were identified as statistically significant influences on cognitive progress for several outcomes. In addition, as well as individual child, parent and home environment measures, the analyses took account of compositional influences. Children in centres which served a higher proportion of children whose mothers were highly qualified in educational terms (had a degree/higher degree or other professional qualification) tended to make more progress in some outcomes, particularly pre-reading. Private day nurseries tended to serve more children from educationally advantaged backgrounds. If compositional effects are not included in the model, this form of provision showed significant positive effects for pre-reading progress. The inclusion of controls for child mobility, compositional effects and pre-school duration mean that the extent of differences between types of provision identified by the model is reduced (because of the way in which such factors are themselves related to type of provision).

No one type of provision was found to be superior to all others in all cognitive outcomes. Outlier centres, both positive and negative, were found in each type of provision. There was significant variation in effectiveness on young children's cognitive progress within each type of provision; thus we can conclude that differences between individual centres are likely to be more important than differences between type. Nonetheless, certain patterns emerged suggesting that some forms of provision were generally more effective. Integrated provision (i.e. combined centres) showed a significant positive impact for several measures. Nursery schools also showed some positive effects compared with other types of provision similar to those found for integrated provision. By contrast, children who attended local authority day care centres tended to make relatively poorer progress, especially for pre-reading. There were interactions for low SES children with type of provision. Children in the low SES group showed better outcomes if they were attended integrated provision (i.e. combined centres) or nursery schools. Both these forms of provision also showed higher scores in observed quality.

Although private day nurseries did not show up as significantly more effective in the analyses of impact of type of provision on progress except in comparisons with local authority day care centres for pre-reading and language, a number of the positive outlier centres for pre-reading were found to be private day nurseries. This may reflect curricular differences in emphasis and priorities. The results suggest that centres classified as private day nurseries in particular show much variation in effects and quality, some having a specific educational philosophy or tradition (e.g. Montessori). It should be noted that the analyses took account of the compositional effects of concentrations of more advantaged children (in terms of mothers' educational levels) in different centres, this is particularly relevant to comparisons of private day nurseries.

The presence of compositional effects would suggest that the clustering of disadvantaged children within specific centres may not be advantageous for young children's cognitive progress. Policies aimed at encouraging a social mix of children may be more appropriate, although this

may be difficult to achieve in practice, given many parents' preferences/needs for a local centre in close proximity to home, and the extent to which different social and ethnic groups are clustered in some neighbourhoods.

The study has demonstrated that there was significant variation both between individual centres and by type of provision in the observed quality of provision (see EPPE Technical Paper 6 for details). When account is taken of variation in quality of centre environments, the impact of type of provision is reduced. This indicates that the impact of type of provision is likely to be, at least in part, attributed to variations in environmental quality and adult-child interactions.

In interpreting the findings on type of provision, it is important to acknowledge the very different resourcing levels typical of different types of provision, which have implications for staffing, training and facilities. The maintained sector differs quite markedly in this respect from voluntary provision, particularly playgroups which, in the past, have had little access to resources in England and often few staff with higher levels of relevant qualifications (for further discussion of these issues see EPPE Technical Paper 5).

Ratios and staff qualifications

Adult child ratios can be measured in several ways. Statutory minimum levels vary by type of provision. However many settings operate with more generous ratios than those statutorily required. Observed ratios (with and without volunteers) were used to provide indicators of staffing levels normally experienced by children aged 3-5 years in individual centres. Statutory, reported (by centre managers) and observed ratios were all tested for links with children's cognitive progress. More generous adult/child ratios showed a significant link with one aspect of children's cognitive progress, early numbers concepts. Elsewhere it has been demonstrated that quality, qualifications and type of provision are themselves associated (EPPE Technical Papers 5 and 6). Ratios tended to be poorer (i.e. higher ratios with more children per adult) in some forms of provision that had more highly qualified staff and higher observed ratings for quality (measured by ECERS-E), although the correlation is fairly low (r=0.21). The exception is integrated centres that have higher quality scores but low ratios.

Centre managers' qualification levels and the proportion of staff hours at different qualification levels also show significant variation between individual centres and by type of provision (EPPE Technical Paper 5). Centre managers' qualifications are significantly associated with the observed quality profiles of centres (EPPE Technical Paper 5). Centres where managers reported they had Level 5 qualifications (e.g. trained teachers[8]) exhibited higher quality. Findings from the associated Researching Effective Pedagogy in the Early Years study (REPEY see Siraj-Blatchford et al, 2002a) also indicate that the observed behaviour of other staff is positively influenced by the presence of a member of staff with Level 5 qualifications.

The multilevel analyses of children's progress found a significant positive relationship between the percentage of Level 5 staff hours and young children's progress in pre-reading. This suggests a link between more highly qualified (i.e. qualified teacher) staff and better child outcomes in pre-reading, although this link may operate indirectly through an impact on centre quality. Given the complex inter-relationships between ratios, staff qualifications, quality and type of provision, plus the extent of variation between individual centres of the same type, these influences on children's outcomes may be confounded (although the significant relationship between the percentage of Level 5 staff hours and young children's progress in pre-reading indicates that staff qualifications are an important factor in these combinations of variables). It may be more relevant for policy makers and practitioners to consider the impacts of *packages* of provision, rather than to try to separate the impact of particular features in isolation.

Children who had no pre-school centre experience

Data were collected for a group of 'home' children with no or only minimal pre-school centre experience. Comparison of the home sample with children who had attended a pre-school centre

[8] For further details of classifications, see EPPE Technical Paper 5.

showed that both the characteristics and attainments of home children vary significantly from those who had been in pre-school. It is not possible to conclude with certainty that the much lower attainments of the 'home' group are directly due to lack of pre-school experience.[9] Nonetheless, the statistical analyses are strongly suggestive that pre-schooling provides a significant cognitive boost.

Contextualised multilevel analyses of attainments at entry to primary school which explored the impact of child, parent and home environment factors illustrate that, even when these important influences are controlled, home children's cognitive attainments are poorer than those of children who attended any of the six types of provision studied. The results also point to a clear link between a longer duration of pre-schooling and higher cognitive attainments, in comparison with the home group (who had not attended a pre-school centre). Although causal connections cannot be drawn, these findings, combined with those on the advantages of an early start date, strongly suggest that pre-schooling has an important positive impact on young children's cognitive attainment. The implication of these results is that children who do not attend a pre-school may be at a disadvantage when they start primary school. Indeed analyses conducted on the EPPE data sets intended to explore 'at risk' status in relation to special educational needs indicate that home children are over-represented in the cognitive 'at risk' category, compared with other EPPE children, even when the level of multiple disadvantage is held constant (EYTSEN Technical Paper 1).

The EPPE research indicates that pre-school can play an important part in combating social exclusion and promoting inclusion by offering disadvantaged children, in particular, a better start to primary school. The findings indicate pre-school has a significant and positive impact on progress over and above important influences such as family SES, mother's qualification level, ethnic and language background, income etc. The quality of the pre-school centre experience as well as the quantity are both influential. The results show that individual pre-school centres vary in their effectiveness in promoting cognitive progress over the pre-school period, and indicate that better outcomes are associated with some forms of provision. Likewise, the research points to the separate and significant influence of the home learning environment. These aspects (quality and quantity of pre-school and home learning environment) can be seen as more susceptible to change through policy and practitioner initiatives than other child or family characteristics, such as SES. Further analyses will explore the progress of the sample who attended a pre-school centre in comparison with the home group over Key Stage 1. Such analyses will help to establish whether the positive impact of pre-school on young children's cognitive development remains significant as children progress through their first years at primary school.

[9] A controlled experiment (which would not be feasible on either ethical or practical grounds) would be needed to draw firm conclusions.

Introduction

Previous research, mainly conducted in the US, has drawn attention to the benefits of high quality early childhood intervention programmes in preparing highly disadvantaged children for school entry (see the best evidence synthesis by Slavin et al, 1994). Longitudinal follow ups of the High Scope programme showed striking social and economic benefits from the carefully controlled random experimental design of intervention, including reduced crime and delinquency and improved adult employment and adjustment (Schweinhart et al, 1993). Very little large-scale systematic research on the effects of early childhood education had been conducted in the UK. In particular, in contrast to the emphasis on experimental intervention studies, little research attention has been given to the study of naturally occurring variation in pre-school provision and the impacts of current provision (including variations in quality of pre-school experiences) and its impact on different groups of young children, not just those in highly disadvantaged circumstances.

The review of evidence by the *Start Right* Enquiry (Ball, 1994) reported that small-scale studies suggest a positive impact for pre-schools on child outcomes, but concluded that large-scale research was inconclusive. The Enquiry recommended the institution of longitudinal studies with baseline measures so that the 'value added' by pre-school education could be established.

McCartney and Jordan (1990) made a comparison of child care effects and school effects research. They argued that the study of child care effects and the school effects field have developed through three parallel phases of research questions.

- Early Phase - Does Educational Environment Matter?
- Second Phase - What Matters?
- Third Phase - What Matters for Which Types of Children?

School effectiveness approaches seek to investigate the impact of schools as social institutions, *'the idea that schools matter, that schools do have major effects upon children's development and that, to put it simply, schools do make a difference' (*Reynolds and Creemers, 1990; p1). Such research explores:

- the impact of social institutions
- the characteristics and processes that promote students' educational outcomes, and
- the influence of contexts on student outcomes.

It has developed a specific methodology focusing on individual students progress which attempts to identify the influence of schools in accounting for variations in the extent of progress made. The methodology is often referred to as a 'value added' approach and adopts multilevel models (a form of hierarchical regression) to separate school level and individual student level variance in student outcomes (Sammons, 1996). The Glossary provides further information about the definition of technical terms used in this report.

McCartney and Jordan (1990) concluded that the parallels between child care and school effects research illustrate the value of each field monitoring the progress of the other. In this way, each may benefit from the conceptual and methodological advances made by the other. It was further argued that the small but growing numbers of longitudinal studies completed in both areas point to the need for studies of long and short term processes and effects.

In the UK there has been a long tradition of variation in the provision for, and access to, pre-school places. In addition, there have been different emphases in terms of focus on education and or care by types of provision (playgroup, local authority, private day nursery, nursery class or nursery schools, and more recently integrated provision (combined centres that provide education and care). Regional variation reflecting differences in local authority emphasis, funding

and geographical conditions (e.g. rural/urban, level of socio-economic disadvantage etc) have also been notable. During the 1990s, a series of reports questioned whether the UK's pre-school education was as effective as it could be and called for better coordination of services and research into the impact of different forms of provision (Siraj-Blatchford, 1995). Sylva (1994) argued that new research should identify the educational processes, including pedagogy, which are associated with positive effects as young children progress and develop, and explore the mechanisms of change.

The case for a major new longitudinal pre-school study in England that explicitly adapts school effectiveness methodology to the pre-school phase and includes a review of relevant literature which informed the development of the Effective Provision of Pre-School Education (EPPE) study, is provided by Sylva et al (1999a).

EPPE is a large-scale longitudinal study funded by the Department for Education and Skills (DfES). It began in 1996 with the aim of investigating which kinds of Early Childhood provision were most 'effective' in promoting young children's progress and development during their time at pre-school, and to explore whether any pre-school effects continue to influence children after they start primary school up until the end of Key Stage 1 (age 7 plus years). The EPPE research is the first study of pre-schools in Europe to use an educational effectiveness design based on sampling children in a range of different pre-school settings and uses statistical approaches (multilevel modelling) that enable the identification of individual centre effects. Beginning around the age of 3 years (at entry to a target pre-school centre, or at their third birthday for children who had already entered a target centre at a younger age), children were assessed at each major change of provision and then at entry to primary school. In this way it has been possible to explore variations between centres in the 'value added' in terms of impact on children's cognitive progress and social behavioural development.

The study follows children for five years from pre-school and across the infant period of primary education. It explores the impact of a wide variety of child, parent and family factors, including aspects of the home learning environment provided by parents. The research seeks to explore whether different types of pre-school provisions differ in their impacts and effectiveness, as well as to identify any variations between individual pre-school centres, in children's cognitive progress and social behavioural development. Measures of the quality of pre-school settings and details of variations in centre policy and practices have been collected from observations by trained researchers and from interviews with centre managers. The study has sought to establish whether such factors have an impact on young children's progress and development. In total 141 pre-school centres drawn from five regions across England form the focus of the EPPE research. Centres were drawn from six types of provision (nursery classes, playgroups, local authority day nurseries, private day nurseries, nursery schools and integrated centres [i.e. combined centres which integrate education and care]).

The EPPE study uses a mixed methods approach, including detailed statistical analyses of effectiveness and in-depth case studies of individual centres. Full details of the EPPE study have been provided in a series of Technical Papers. The present paper is based on statistical analyses for a sample of over 3100 children (including the additional 'home children recruited at start of primary school). A wide range of information has been drawn on, including individual assessments of children at entry to pre-school (age 3 years plus) and followed up again at entry to school (typically age rising 5 years) as well as child care workers' assessments of social behavioural development. Detailed information about children's health, and care histories, family characteristics and home learning environments was collected from parental interviews. Trained researchers conducted detailed observations in each centre which provide information about the quality of provision, and centre managers were interviewed to provide details about a range of centre policies and practices.

The EPPE Project child database contains rich information about pre-school children's personal and family characteristics and details of their home learning environment. The analysis of

children's cognitive assessments at entry to the study (age 3 plus years) revealed important relationships between cognitive attainment and social behavioural development and these background characteristics (see EPPE Technical Papers 2 and 4 for details).

Aims

The aims of the multilevel analyses are shown below.

- To explore the impact of a range of child, parent and home characteristics on pre-school children's attainment at primary school entry and on their progress and development over their time in pre-school.
- To model young children's cognitive progress and social development across the pre-school period until entry to primary school.
- To establish whether there is significant variation between individual pre-school settings (pre-school centres) in their effects on different child outcomes (cognitive and social behavioural).
- To explore the impact of measures of pre-school process, particularly measures of quality and of staff qualifications.
- To explore the impact of pre-school, including any variations in children's outcomes for those who attended different types of pre-school (and those who received no pre-school provision, the 'home' sample).

Research questions addressed

1. *What is the variation in children's school entry assessments for different groups of children?* (e.g. girls compared with boys, those from different ethnic or language backgrounds, those whose parents have different levels of educational qualifications, or from different socio-economic groups) Of particular interest will be the question of whether the variation between different groups of children has increased or decreased over the pre-school period which may indicate whether pre-school experience helps to reduce inequalities in cognitive attainments which were evident at age three plus, and may thus contribute to the long term policy aim of reducing social exclusion.

2. *What is the impact of amount and duration of pre-school experience?* Children's pre-school 'careers' are very varied. Does more pre-school experience result in higher cognitive attainment at school entry when account is taken of the impact of other factors? Are different groups of children equally affected, or is more experience particularly beneficial for disadvantaged groups? These results should help to inform policy makers about the relative benefits which may be expected to arise from policies that increase pre-school provision.

3. *What is the extent of child mobility (in terms of change of pre-school centre) evident for children in the pre-school period?* In particular does a change of pre-school centre before starting primary school show a significant association with young children's cognitive progress and/or their social behavioural development?[10]

4. *Do individual pre-schools vary in their effectiveness in promoting young children's cognitive progress and social behavioural development?* Due to the extent of differences between individual centres in the characteristics of the children in the intakes they serve, it is essential to take account of such differences in any comparisons of child outcomes measured at the start of primary school. It is also of particular interest to establish whether centres vary in their effectiveness in different domains. Are the same centres which are found to promote progress in one area, say language, also more effective in promoting other cognitive or social behavioural outcomes?

[10] A future EPPE Technical paper will focus in detail on the issue of child mobility during the pre-school period and in particular on those children who experience highly mobile pre-school careers. It will explore whether discontinuity/fragmentation of experience (frequent changes of pre-school centre) has an adverse impact on children's cognitive and social behavioural development as measured at primary school entry and at the end of year 1.

5. *Does type of pre-school experience matter?* Taking account of differences in the prior attainment of children at entry to pre-school, and amount of provision experienced, do children attending certain types of pre-school (playgroup, nursery class, private day nursery, local authority day nursery, nursery school or integrated centre) make more or less progress by the time they enter school? If type of pre-school does matter, do some groups do better (e.g. disadvantaged groups or boys make more progress) with certain types of provision?

6. *Does the quality of the pre-school setting have a significant impact on young children's cognitive progress and social behavioural development*? A range of observational measures of environmental quality and staff child interactions were collected for the EPPE research. Analyses explore whether these show a statistically significant association with better child outcomes at the start of primary school

7. *How do children entering school without any pre-school experience differ from their peers who have attended centres in the main EPPE pre-school sample?* The analysis will compare the personal and background characteristics of 'home' children (those without pre-school centre experience with those of the EPPE sample who attended a pre-school centre) to establish whether 'home' children are drawn from specific groups. It will also compare the school entry attainments of such children to establish whether they are lower than those of children who attended a pre-school centre.

Methods

The analyses employ a range of statistical techniques from descriptive and correlation analysis of the reception measures to multilevel (hierarchical) regression methods to examine children's progress over the pre-school period (see Goldstein, 1995 for details of multilevel modelling approaches in the study of institutions). The multilevel analyses are central to the study of child progress and the impact of pre-school. These analyses allow the variation in children's outcomes measured at entry to primary school to be separated into that which reflects variation between children, and that which reflects variations between centres. Multilevel models provide more accurate assessments of the impact of different child or centre level characteristics, and enable the calculation of value added estimates (residuals) of individual centre level effects. These residuals measure the difference between the expected and actual results, after controlling for differences in important characteristics such as prior attainment (most important) but also child, parent and home environment characteristics like age, gender, socio-economic status (SES), frequency parent reports reading to child etc. An important feature of the value added analysis is the calculation of the confidence limits associated with each centre level residual estimate. These allow us to establish whether variations between individual centres are statistically significant and to identify outlier centres (those which show particularly positive or negative value added effects).

Background information about child, parent and family characteristics, was obtained through parent interviews. Parent interviews were conducted soon after children were recruited to the study. It should be noted that most interviews were with children's mothers and usually took place at the child's pre-school centre, although for some working parents telephone interviews were found to be more convenient. All parents had agreed to their child taking part in the EPPE study and given written consent. The parent interviews were designed to obtain information about a child's health and care history, details of family structure and parent's own educational and occupational backgrounds as well as some indications of parent-child activities and routines. Parents were assured of confidentiality and anonymity in presenting results. An excellent response rate (97%) to the interview was achieved, although in some instances particular questions had a slightly lower rate of response (e.g. related to occupations). In most cases the parent interviews were conducted within 10 weeks of recruiting a child to the study, though for a small number of children in 'hard to reach' groups a longer time gap sometimes occurred.

This report describes the results of analyses of young children's cognitive progress during their time in pre-school. Equivalent analyses of the social behavioural development of children in the

study have been conducted. The results are reported separately in EPPE Technical Paper 8b. Progress has been measured from entry to the EPPE study (age 3 years plus) until the start of primary school (usually measured at entry to reception classes at rising 5 years, though in some regions children can be enrolled directly into Year 1 classes and did not join a reception class). Five measures of cognitive attainment assessed at entry to primary school have been studied; language, two measures of non-verbal skills, early number concepts and pre-reading. A range of statistical methods has been used to analyse data for around 2800 children who were recruited from target pre-schools and followed up to the start of primary school, representing around 95 per cent of the total child sample at entry to the study. Multilevel modelling has been used to identify and explore pre-school centre effects and the 'value added' by different centres using this sample. An additional group of over 300 'home' children recruited at entry to primary school brings the total sample to over 3100 children for some analyses.

Structure of Main Report and Analyses

This report is divided into six sections. The first provides some descriptive statistics concerning the characteristics of the EPPE sample and investigates whether particular groups of pupils show differences in their school entry assessments in the five cognitive areas examined.

The second section addresses the question of the extent to which different child, parent and home environment background characteristics account for variation in attainments in the five school entry assessments. This section uses multilevel modelling techniques so that the net influence of different background factors on children's attainments at different ages can be ascertained. These contextualised analyses are equivalent to those conducted at entry to pre-school (see EPPE Technical Paper 2), although further measures were tested at primary school entry. A comparison of the results of the analyses at the two different time points allows us to establish whether background influences change (reduce or increase) over the pre-school period. Contextualised analyses are used to identify the unique (net) contribution of particular characteristics to variation in children's outcomes, in this instance their attainments in different cognitive assessments, while other influences are controlled. Thus, for example, the impact of family SES, is established while taking into account the influence of mother's qualification levels, low income (measured by eligibility for free school meals), ethnicity, birthweight, home learning environment, etc. It is of policy interest to establish the nature and strength of such background influences individually and in total, because they are relevant to issues of equity and social inclusion.

The third section describes the results of value added multilevel models which investigate child progress over their time in pre-school (by controlling for a child's age at assessment and prior attainment at entry to the study). These analyses enable the EPPE research to establish whether there is evidence that pre-school influences young children's cognitive gains. In particular, the extent to which children's cognitive progress is statistically associated with the individual pre-centre they attended can be calculated. The centre level variance provides an indication of the size of any effect related to pre-school attended. The calculation of centre level residuals can be interpreted as value added indicators of centre effectiveness. Centres where children made significantly greater progress than predicted on the basis of prior attainment and intake characteristics can be viewed as *more effective* (significant positive outliers in value added terms), while centres where children made less progress than predicted can be viewed as *less effective* (significant negative outliers in value added terms).

In the fourth section the multilevel analyses are extended to establish the extent to which factors such as type of pre-school attended, number of sessions, quality characteristics, ratios and staff qualifications show any statistically significant relationship with cognitive progress. Do variations in quality and extent of time in pre-school have an impact on cognitive gains and, in particular, does higher quality and more pre-school experience have a positive impact?

The fifth section presents findings concerning a sample of 'home children' who have had no or only very limited pre-school experience before starting primary school, in comparison with the pre-school sample. The inclusion of a sample of 'home children' enables the study to provide

further information about the impact of pre-school provision as a whole (rather than just examining variations amongst children who attended different settings and types of provision). The analyses explore whether home children are at a cognitive disadvantage when they start primary school and the extent to which any attainment gap can be attributed to the absence of pre-school centre experience, rather than to differences in the characteristics of home children, compared with the main EPPE sample.

The last section of the paper summarises the results drawing together the main findings and conclusions and noting links with recent research in the US.

Section 1: Characteristics of the Sample at Primary School Entry

The research design used to recruit the sample for the EPPE study is described in detail in EPPE Technical Paper 1. In summary, six English Local Authorities (LAs) in five regions participated in the research with children recruited from six main types of provision: nursery classes, playgroups, private day nurseries, LA day care nurseries, nursery schools and integrated (combined) centres. In order to enable comparison of centre and type of provision effects the project was designed to recruit 500 children, 20 in each of 20-25 centres, from the various types of provision. In some LAs certain forms of provision are less common and others 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 (e.g. rural playgroups), more of these centres were recruited than originally proposed, bringing the sample total to 141 centres and over 3000 children. [11]

In terms of this paper, the sample with matched data (in other words, data at both assessment time points i.e. entry to the study and entry to primary school) is 2857 children from 141 centres. Table 1.1 reports the number of centres and EPPE children in each type of provision. Additionally, the mean number of EPPE children in a type of provision is provided as well as information on the spread of EPPE children in each type of provision (i.e. standard deviation and range) (Chart A.1 in Appendix A shows in graph format the number of EPPE children in the pre-school centres).

Table 1.1 Descriptive Statistics of the EPPE Sample by Type of Provision

	Centres	EPPE Children			
	n	n	mean	sd	range
Nursery class	**25**	**588**	**23.52**	**3.14**	**13-28**
Playgroup	**34**	**609**	**17.91**	**4.65**	**10-28**
Private day nursery	**31**	**516**	**16.65**	**5.14**	**6-27**
LA day care	**24**	**433**	**18.04**	**5.01**	**10-28**
Nursery school	**20**	**519**	**25.95**	**2.37**	**19-30**
Integrated centre	**7**	**192**	**27.43**	**3.55**	**25-35**
All	**141**	**2857**	**20.26**	**5.66**	**6-35**

Table 1.2 shows the number and percentage of mobile children (i.e. those who had made a change of centre during the course of the EPPE study) by pre-school type. It can be seen that overall just under a quarter of the sample (23.0%) had moved from the target pre-school centre from which they were recruited at entry to the study during the pre-school period. However, far more children were identified as mobile for certain forms of provision. Children attending nursery classes, nursery schools and integrated centres were least likely to have changed centre, while the majority of those in playgroups had moved centre. Children who left their target pre-school were tracked in their new settings and re-assessed there. They were also followed up into primary school to maintain sample size and so that the impact of mobility could be analysed for

[11] Only a small number of integrated centres were recruited because nationally there were few examples of this relatively recent form of pre-school provision in existence at the start of the project.

this young age group. A further paper will focus in greater detail on the nature and extent of mobility amongst the EPPE sample and its impacts.

Table 1.2 Number and Percentage of Children Changing Pre-school Centre Before Primary School Entry by Type of Provision

	n of children	% of children	n of centres
Nursery class	**16**	**2.4**	**25**
Playgroup	**340**	**51.7**	**34**
Private day nursery	**157**	**23.9**	**31**
LA day care	**121**	**18.4**	**24**
Nursery school	**11**	**1.7**	**20**
Integrated centre	**13**	**2.0**	**7**
All	**658**	**23.0**	**141**

Cognitive Assessments at Entry to Primary School

All EPPE children were assessed at entry to primary school, providing a measure of current attainment at exit from pre-school and a baseline measure for entry to primary school. The assessments are shown in Table 1.3 and were specifically designed to be compatible with the Desirable Outcomes for Pre-School Education (DfEE, 1996) that has since been replaced by the Early Learning Goals (DfEE / QCA, 1999 and 2000).[12]

Table 1.3 Cognitive Assessments Taken at Entry to Primary School

Name of Assessment	Assessment Content	Administered one-to-one by:
British Ability Scales Second Edition (BASII) (Elliot et al, 1996):	Cognitive development battery	
• Verbal comprehension	• Verbal skills	EPPE Researcher
• Picture similarities	• Non-verbal reasoning skills	EPPE Researcher
• Naming vocabulary	• Verbal skills	EPPE Researcher
• Pattern construction	• Spatial awareness/reasoning	EPPE Researcher
• Early number concepts	• Reasoning ability	EPPE Researcher
Letter recognition	Lower case letters	EPPE Researcher
Phonological awareness (Bryant and Bradley, 1985)	Rhyme and alliteration	EPPE Researcher
Children not fluent in English: Assessed only on two of the non-verbal BAS II scales (Picture Similarity and Pattern Construction). In addition they were assessed on BAS II Copying, a measure of spatial ability, (Elliot et al, 1996), which was also administered by the EPPE researcher		

A number of the assessments were added together to form 'composite' outcomes. For example, the two verbal BAS II scales (Verbal Comprehension and Naming Vocabulary). The pre-reading composite is formed by adding together the scores for phonological awareness (rhyme and alliteration) and letter recognition. A comparison of Charts A.2–A.5 in Appendix A indicates that the distribution of the pre-reading composite is fairly normal, in contrast to the individual sub-scales (in particular the sub-scale letter recognition). The distribution for letter recognition shows a large proportion of children with low and high scores, with fewer children scoring in the middle of the range. This is a fairly common pattern for letter recognition for this age group of children,

[12] Measures of children's social behavioural development were also collected (based on the ASBI, Hogan et al, 1992). Results are given in EPPE Technical Paper 8b.

as young children tend to either recognise none of the alphabet or recognise most of the alphabet.
To summarise, the five cognitive outcomes reported in this Technical Paper are **pre-reading**, **early number concepts**, **language, non-verbal reasoning** and **spatial awareness/reasoning**. Details such as mean and spread of the data (i.e. standard deviation [sd] and range) of the primary school entry assessments are shown in Table 1.4 whilst Charts A.2, A.6-A.9 in Appendix A show their respective distributions graphically. The distributions of the five cognitive outcomes can be described as normal although the distribution for spatial awareness/reasoning shows a degree of skewness to the left, indicating a predominance of scores at the lower end of the range.

Table 1.4 The Distribution of Children's Scores on the EPPE School Entry Assessments

	n	mean	sd	range
Pre-reading	**2705**	**21.57**	**12.67**	**0 - 46**
Early number concepts	**2711**	**18.50**	**5.66**	**0 – 32**
Language	**2725**	**42.13**	**7.68**	**0 – 68**
Non-verbal reasoning	**2733**	**22.38**	**4.54**	**0 – 33**
Spatial awareness/reasoning	**2585**[13]	**11.60**	**7.27**	**0 - 41**

Table1.5 shows the correlations (a measure of statistical association which ranges from +1 to –1) between children's scores on the different primary school entry assessments. All the correlations are moderately high ranging between 0.41 and 0.60. The strongest statistical association is between children's scores on pre-reading and early number concepts whilst the weakest correlation is between language and spatial awareness/reasoning. Charts A.10 and A.11 in Appendix A show the degree of these associations graphically.

Table 1.5 Correlations Between Children's Primary School Entry Assessments

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness / reasoning
Pre-reading	**1.00**	**0.604**	**0.550**	**0.418**	**0.447**
Early number concept		**1.00**	**0.590**	**0.511**	**0.534**
Language			**1.00**	**0.503**	**0.409**
Non-verbal reasoning				**1.00**	**0.424**

All correlations are significant at the 0.01 level

Table 1.6 provides descriptive statistics for the EPPE sample. Given the implications for schools in promoting greater equity in subsequent educational outcomes, it is of interest to compare the scores on the five cognitive outcomes for various subsets of children to see if certain groups of children have lower attainment at entry to primary school. As children continue through the educational system, further analyses will be conducted to explore the attainment and progress of these children during Key Stage 1 to establish whether the 'gap' in achievement reduces or remains constant as they progress through school.

[13] Approximately 200 children took the BAS block building assessment at entry to primary school. However, a ceiling effect was quickly noted so BAS block building was replaced by BAS pattern construction (a measure of spatial awareness/reasoning) for the remaining children.

Table 1.6 The Characteristics of the EPPE Sample at Primary School Entry

		n	%
Gender:	**male**	1489	52.1
	female	1368	47.9
Ethnicity*:	**White UK**	2127	74.5
	White European	118	4.1
	Black Caribbean	116	4.1
	Black African	64	2.2
	Black other	22	0.8
	Indian	55	1.9
	Pakistani	75	2.6
	Bangladeshi	25	0.9
	Chinese	5	0.2
	Other	62	2.2
	Mixed heritage	185	6.5
English as a Second Language		249	8.7
Receiving free school meals		598	22.5
3 or more siblings		374	13.4
Mother has no formal qualification		501	18.1
Area:	**East Anglia**	559	19.6
	Shire Counties	594	20.8
	Inner London	656	23.0
	North-east	503	17.6
	Midlands	545	19.1

*not known excluded total n=2857

Gender

The extent of variation in children's school entry assessments related to gender is a topic of considerable practitioner and policy interest given later evidence of gender differences in pupils' achievements in National Assessments at all Key Stages. Table 1.7 provides descriptive statistics comparing boys' and girls' performance at entry. It can be seen that girls' scores, on average, are slightly higher for each assessment. Nonetheless, the differences are small and there is considerable overlap in the performance of the two groups.

Table 1.7 The Distribution of Children's Scores on the EPPE Primary School Entry Assessments by Gender

	Boys			Girls		
	n	**mean**	**sd**	**n**	**mean**	**sd**
Pre-reading	**1420**	**20.09**	**12.34**	**1285**	**23.21**	**12.84**
Early number concept	**1424**	**18.06**	**5.76**	**1287**	**19.00**	**5.01**
Language	**1435**	**41.91**	**7.56**	**1290**	**42.38**	**7.82**
Non-verbal reasoning	**1439**	**22.08**	**4.56**	**1294**	**22.72**	**4.51**
Spatial awareness/reasoning	**1355**	**11.34**	**7.26**	**1230**	**11.88**	**7.26**

Language

The descriptive statistics for the primary school entry assessments of children for whom English was an additional language (EAL) compared with children for whom English was their mother tongue (Table 1.8) showed that, as might be expected, the attainments of EAL children were substantially lower in all assessments. Not surprisingly, the difference was largest for the language composite and smallest for the two non-verbal assessments. For all outcomes except

pre-reading, the spread of attainment (measured by the standard deviation) was greater for EAL children suggesting that this group of children are less homogenous in terms of attainment scores than other children.

Table 1.8 The Distribution of Children's Scores on the Primary School Entry Assessments by Language

	English as mother tongue			English as an additional language		
	n	mean	sd	n	mean	sd
Pre-reading	2523	21.69	12.69	182	19.92	12.31
Early number concept	2523	18.71	5.56	188	15.66	6.21
Language	2532	42.81	7.16	193	33.18	8.66
Non-verbal reasoning	2532	22.47	4.45	201	21.24	5.46
Spatial awareness/reasoning	2395	11.67	7.26	190	10.75	7.38

Mother's qualification level

The analyses of children's BAS scores at entry to pre-school revealed that mother's qualification level showed a strong association with children's cognitive attainment (see EPPE Technical Paper 2). Table 1.9 summarises the findings of the main qualification groups when differences at entry to school are examined. Again a clear trend can be seen, with children whose mothers have no formal qualifications showing the lowest cognitive scores, while those whose mothers have degrees or higher degrees the highest scores. The results show marked differences between the performance of children whose mothers are at the top and bottom of the qualification scale in each measure.

Table 1.9 The Distribution of Children's Scores on the EPPE School Entry Assessments by Mother's Qualification Level

	Mother no qualifications			Mother vocational qualification			Mother academic qualification at 16		
	n	mean	sd	n	mean	sd	n	mean	sd
Pre-reading	463	14.97	10.98	411	19.73	11.98	1006	20.32	11.90
Early number concept	467	15.74	5.87	412	18.03	5.02	1007	18.41	5.59
Language	472	37.93	7.65	413	40.97	6.522	1009	41.76	6.66
Non-verbal reasoning	479	20.69	5.01	413	22.34	4.24	1010	22.09	4.38
Spatial awareness/ reasoning	456	8.84	6.48	396	10.82	6.24	947	11.38	7.12

	Mother academic qualification at 18			Mother degree			Mother higher degree		
	n	mean	sd	n	mean	sd	n	mean	sd
Pre-reading	238	25.05	12.47	358	29.25	11.86	124	33.29	8.88
Early number concept	239	19.79	5.30	358	20.88	5.20	124	22.18	3.89
Language	240	44.01	8.08	359	46.89	7.83	125	48.62	7.06
Non-verbal reasoning	240	22.67	4.51	359	24.57	3.86	125	24.67	3.80
Spatial awareness/ reasoning	223	12.19	7.01	339	14.67	7.48	122	16.66	8.64

Categories 'other professional' and 'miscellaneous' excluded due to the small number of mothers in these categories

Family SES

Table 1.10 shows the distribution of children's attainments on the five outcomes measured at entry to primary school by family SES (based on parents' highest occupational level using mother's and father's employment information). The results show that the average attainments of children from the highest group (professional non-manual) are much better than those of children from lower SES groups.

Table 1.10 The Distribution of Children's Scores on the EPPE School Entry Assessments by Family SES Level

	Professional non-manual			Intermediate non-manual		
	n	mean	sd	n	mean	sd
Pre-reading	263	30.68	10.85	722	25.29	12.44
Early number concept	263	21.40	4.98	723	20.13	5.04
Language	263	47.34	7.05	724	44.89	7.17
Non-verbal reasoning	263	24.57	3.59	725	23.22	4.35
Spatial awareness/reasoning	254	14.93	7.44	687	12.78	7.46

	Skilled non-manual			Skilled manual		
	n	mean	sd	n	mean	sd
Pre-reading	885	20.46	12.24	328	17.63	11.05
Early number concept	885	18.32	5.39	330	17.35	5.28
Language	888	41.65	6.89	333	39.82	7.07
Non-verbal reasoning	891	22.15	4.43	336	21.62	4.49
Spatial awareness/reasoning	839	11.44	6.89	312	10.08	6.46

	Semi-skilled manual			Unskilled manual			Never worked		
	n	mean	sd	n	mean	sd	n	mean	sd
Pre-reading	340	15.97	11.11	59	13.41	11.49	60	17.65	12.14
Early number concept	342	15.53	6.07	59	15.39	5.32	61	16.61	6.76
Language	344	38.23	7.22	60	37.38	5.75	63	35.27	10.22
Non-verbal reasoning	344	21.15	4.49	60	19.93	4.62	64	20.34	6.55
Spatial awareness/ reasoning	322	8.98	6.57	59	9.54	7.99	64	10.27	7.88

Section 2: Children's Cognitive Attainments at Primary School Entry: Results From Contextualised Multilevel Analyses

This section presents the results of a contextualised multilevel analysis establishing the pattern of relationships between child, family and home environment characteristics and children's cognitive attainment at primary school entry.[14] The five cognitive attainments discussed in Section 1 are employed as outcomes in the contextualised multilevel models. Background details about children's earlier childcare experiences, health, family and home learning environment have been obtained from parental interviews conducted when children entered the EPPE study.

Of interest, is whether the associations between cognitive attainments and various child, family and home environment factors at primary school entry are similar to the patterns found when children were younger (at pre-school entry age 3 years plus). In particular, it is important to establish whether the power of such factors to account statistically for the variation between children in their attainment at school entry is weaker or stronger than at pre-school entry. This is of both theoretical and policy interest. If such factors account for a lower percentage of variance in some measures of attainment at entry to primary school, this may indicate a possible pre-school influence, particularly if the variance at pre-school centre level has increased in comparison with the findings reported at pre-school entry (see EPPE Technical Paper 2). The value added analyses of child progress over the pre-school period reported subsequently in Section 3 will shed further light on the issue of the impact of individual pre-schools. The extent of differences in school entry attainment attributable to a child's background is also of interest in its own right, given the equity implications for later progress at school, and the challenges facing early years teachers.

Multilevel models provide a method of exploring the extent of variation in children's cognitive attainments (and progress) which can be attributed to differences between individual children and group attributes such as the area in which they live or the institution they attend.[15] In terms of the contextualised analysis reported here in Section 2, the contextualised multilevel models allow an exploration of the variation in children's attainments in school entry assessments in terms of centre level variation and the extent of differences related to particular child, family and home environment characteristics.

Table 2.1 shows the null models (i.e. with no explanatory variables included) for the five cognitive outcomes. The intra-centre correlation measures the extent to which the scores of children in the same centre resemble each other as compared with those from children at different centres. The intra-centre correlations for language and pre-reading indicate that approximately a quarter of the variation in children's language and pre-reading scores is attributed to systematic differences between pre-school centres, while the majority (nearly three-quarters) reflected differences between individual children. These proportions are in line with studies of older age groups at primary school age (see for example Mortimore et al, 1988; Sammons and Smees, 1998). The intra-centre correlations for early number concepts, non-verbal reasoning and spatial awareness/reasoning are lower, indicating that between 12% and 17% of total variance lies between centres. This difference in the size of intra-centre correlations for five outcomes for the same child sample suggests that pre-school centres may have more influence on cognitive development in specific areas and will be explored further using contextualised and value added models (see Section 3 of this report).

[14] Children's cognitive attainment at entry to primary school will also provide a baseline for later assessment of progress across, for example, the reception year or Key Stage 1.

[15] Multilevel models are a generalised form of regression analysis, particularly suited to the study of educational and social data exhibiting a hierarchical structure (Paterson and Goldstein, 1991; Goldstein, 1995)

Table 2.1 Null Model Showing Pre-school Centre and Child Level Variance

	Pre-Reading	Early Number Concepts	Language	Non-verbal reasoning	Spatial awareness / reasoning
Centre level variance: estimate (se)	38.23 (5.38)	5.59 (0.84)	15.77 (2.16)	2.54 (0.42)	8.24 (1.30)
Child level variance: estimate (se)	123.40 (3.45)	26.83 (0.75)	44.50 (1.24)	18.10 (0.50)	44.84 (1.28)
Intra-centre correlation	0.24	0.17	0.26	0.12	0.16
Number of children (number of centres)	2705 (141)	2711 (141)	2725 (141)	2733 (141)	2585 (140)

The results from a contextualised analysis, where explanatory variables related to child, family and home environment characteristics are added to the multilevel model to control for the influence of background characteristics, are reported in Table 2.2. The intra-centre correlation varies between the outcomes, ranging from 9 per cent for pre-reading to 2 per cent for non-verbal reasoning. This indicates that differences in children's pre-reading and early number attainments show more variation between individual pre-schools than other cognitive outcomes.

Table 2.2 Contextualised models (at entry to study and at entry to primary school) showing pre-school centre and child level variance

	Entry to Primary School					Entry to study (3+)
	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning	Language
Centre level variance: estimate (se)	8.71 (1.70)	1.33 (0.30)	1.07 (0.34)	0.37 (0.15)	1.61 (0.46)	1.27 (0.44)
Child level variance: estimate (se)	92.94 (2.71)	20.06 (0.58)	31.76 (0.92)	15.14 (0.44)	38.03 (1.12)	41.47 (1.21)
Intra-centre correlation	0.086	0.062	0.032	0.024	0.041	0.030
% Reduction in centre level variance	76.75	75.70	92.92	84.88	80.99	92.55
% Reduction in child level variance	25.07	24.30	27.50	16.02	14.82	28.86
% Reduction in total variance	37.06	33.08	46.04	24.36	28.40	43.25
Number of children (number of centres)	2487 (141)	2494 (141)	2511 (141)	2526 (141)	2455 (140)	2481 (141)

It should be noted that the contextualised models at primary school entry include a measure of amount of time children spent in the target pre-school (the duration measure is based on the number of months from start date at target pre-school until entry to primary school). This measure shows a significant positive impact on levels of cognitive attainment at primary school entry. The estimate of pre-school centre influence (intra-centre correlation) shown in Table 2.2, thus is calculated after control for time in pre-school (which can also be seen to measure an important feature of the impact of pre-schooling).

The intra-centre correlation represents the extent to which individual pre-school centres differ in their impact on attainment in these contextualised models. If all centres were equally effective the intra-centre correlation would be zero, but this would not mean that pre-schooling had no impact, rather that centres did not differ in their impact on cognitive attainment. It should also be noted in interpreting the results that, while the size of the intra-centre correlation seems small (under 9%) this does not imply that the pre-school influence is small. Indeed it is larger in percentage terms than the net influence of other important factors such as family SES and low income (measured by free school meals) for pre-reading and early number concepts. In terms of total variance in child outcomes in pre-reading, for example pre-school centre attended accounts for over 5%, whereas the net impact of family SES and FSM accounts for under 2%,[16] when other factors are controlled. Gage (1984) has drawn attention to the educational importance of measures which account for very small proportions of total variance and made comparisons with medical research where interventions which account for under 1% of total variance have been shown to be of great importance in improving outcomes.

The impact of child, family and home environment factors on attainment at primary school entry can be compared to the impact of these factors on attainment at pre-school entry. Table 2.2 also shows the equivalent contextualised analysis for the sample using language scores at pre-school entry as the dependent variable for the whole sample.

It can be seen that child, family and home environment factors in combination accounted for a similar percentage of the total variance and centre level variance in children's total verbal BAS (language) scores at entry to the study (age 3 years plus) as at entry to primary school (age 5). These findings suggest that there is no reduction in the strength of background influences on young children's language outcome between the ages of 3 and 5 years. By contrast it can be seen that the influence of such factors on attainments in pre-reading, and early number concepts is weaker, with greater evidence of possible centre level differences. It should be noted that these analyses also take into account duration of pre-school (from date of entry assessment to entry to primary school).

Given the identification of important relationships between child, family and home environment characteristics and children's attainment in the cognitive outcomes identified at entry to pre-school age 3 years plus,[17] the contextualised model investigates any continuing impact of these measures on young children's attainment at entry to primary school. In this way the impact of, for example, number of siblings or of premature birth can be established net of the influence of other factors. The contextualised models indicate that, for all five attainment outcomes, a number of child, family and home environment characteristics show statistically significant relationships with attainment at entry to primary school. Tables B.1–B.3 in Appendix B summarise these results in a tabular format for 3 of the 5 outcomes, showing the size of differences in raw score points. Details on effect sizes are also reported in Chart 2.1, and a brief description of calculation and general issues regarding effect sizes are given in Appendix B. It should be noted that some effect sizes for categorical measures may be large but apply to only very small numbers of children (e.g. low birthweight or specific ethnic groups), while others for continuous measures may appear relatively modest but generally apply to all children.

The main findings in terms of individual child, family, home environment and other characteristics are described in detail on the following pages.

Child Measures

Gender differences in attainment at primary school entry in favour of girls were identified for all outcomes except language. These differences though significant were only small to moderate in size. Age in months at reception assessment was significant for all five outcomes as might be

[16] Some additional analyses were conducted to explore the net impact of specific measures or groups in terms of total variance explained.

[17] The contextualised results at entry to the study (age 3 years plus) are described in EPPE Technical Paper 2.

expected, with older children showing significantly higher attainments. The effects of age on attainment were very strong, reflecting the importance of age in developmental terms for young children.

The group of children with low birth weight[18] had significantly lower pre-reading, non-verbal reasoning and spatial awareness/reasoning scores at primary school entry than children classified as normal/above normal birth weight. Children classified as very low birth weight had significantly lower early number scores and language scores at school entry. The impact of very low birthweight for early number concepts echoes findings reported recently in medical research that suggests a link between very low birthweight and specific features of brain development (Richards et al, 2001).

Children from larger families (with 3 or more siblings) also showed significantly lower scores for pre-reading, early number concepts and language. Again this is in line with findings at entry to the pre-school study.

Children with English as an additional language attained significantly lower scores on the early number concepts and language outcomes, though not for pre-reading. For ethnicity, the relationships (in comparison to the white UK group) also varied markedly as follows:

- Black African children showed significantly higher pre-reading scores in comparison with the White UK group, while the White European group showed significantly lower pre-reading scores.

- Children from the Pakistani ethnic group tended to attain lower scores in early number concepts, non-verbal reasoning and spatial awareness/reasoning than the White UK ethnic group.

- For language attainment the scores of nearly all ethnic groups (White European, Black African, Black Caribbean, Indian, Pakistani, Bangladeshi, Mixed Heritage and the other group) were significantly lower than the White UK group

- the Black Caribbean group recorded significantly higher non-verbal reasoning scores.

These results show that the choice of different assessments to measure of children's attainment at primary school entry may have equity implications. It appears that ethnic differences are more likely to be identified in measures of children's language attainment than in non-verbal, early number concept or pre-reading skills. While the findings here refer to the EPPE sample, this issue is likely to apply to reception baseline schemes in general (see also the discussion of equity issues in relation to different forms of baseline assessment by Sammons et al,1999). It should be stressed that these ethnic and language differences are net of the influences of all other factors included in the model, including SES and mother's qualification in which there are also significant differences between ethnic groups.

Family Measures

The results indicate that the free school meals (FSM) measure of socio-economic disadvantage[19] (despite its limitations for this young age group where home dinners are more common) showed a negative relationship with all attainment measures at entry to pre-school except spatial awareness/reasoning. Though significant, this impact was not strong (in terms of raw points scores smaller than the gender difference for pre-reading for example). It was not possible to control for measure of low income in the original analyses for total BAS scores (reported previously in EPPE Technical Paper 2) because free school meals data does not exist for pre-

[18] Babies born weighing 2500 grams (5lbs 8oz) or less are defined as below normal birth weight: fetal 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 Caren, 1989).

[19] Note that, unlike the other family measures collected at entry to the study, the FSM measure is collected at entry to primary school.

school children and asking parents about their income was considered too sensitive for inclusion in the initial parent interview. Nevertheless, receiving free meals at primary school entry is likely to indicate previous low income status.

Mother's highest educational qualification[20] as measured by degree and higher degree level showed a positive, strong and significant consistent impact across all five cognitive outcomes (compared with the group no qualifications). For example, in terms of point scores the net impact was roughly twice the size of the gender gap for pre-reading and early number concepts, when the groups 'mother with degree or higher degree' are compared with 'mother no qualifications'. In addition, a number of other qualification levels showed a positive significant relationship with each attainment outcome, once again in comparison to children whose mothers have no qualification:

- for pre-reading, academic qualifications at age 18 and 'other professional qualification'

- for early number concepts and language, academic qualifications at age 16 and 18

- for non-verbal reasoning, vocational qualifications at age 16 and 18

- for spatial awareness/reasoning, all qualifications except the 'other professional qualification' group.

The equivalent qualification variable for fathers is only significant for the pre-reading outcome with children whose fathers have a degree showing higher attainment at entry to primary school than children whose fathers have no qualifications. Similarly, fathers' employment status is only significant for one outcome (non-verbal reasoning), with the 'other' category (including part-time employment) showing a negative significant impact with non-verbal reasoning compared to full-time employment. When variables measuring mother's employment status are tested individually in the contextualised model, a significant positive relationship for mother's working full time is noted for all 5 outcomes in comparison with the group mother not working. However, it should be noted that mother's employment status at the child's entry to the EPPE study is no longer significant when other significant parent variables (such as mother's highest qualification) are added to the contextualised model. There is no evidence that children whose mothers work either part or full time[21] have lower cognitive attainments at the start of primary school.

In terms of parents' highest social class of occupation (family SES), compared with professional occupations (Class I), all other categories are associated with lower attainment levels. Significant differences in terms of children's attainment are noted between children whose parents' highest social class of occupation is professional Class I and the following:

- for pre-reading and early number concepts, children from families where the highest social class of occupation is non manual III, manual III and manual IV/V

- for language, children from families where the highest social class of occupation is non manual III, manual III and manual IV/V or have never worked

- for non-verbal reasoning, children from families from all other categories

- for spatial awareness/reasoning, children from families where the highest social class of occupation is manual III and manual IV/V.

[20] This information was collected in the parental interview at entry to the study.
[21] The information on mother's employment was collected in the parental interview at entry to the study and relates to a mother's employment status when her child entered the EPPE study (age 3+). There is no information available on mother's employment status before her child entered the EPPE study.

Overall therefore these results show that children whose parents' highest SES is non-manual professional and other managerial (classes 1 and 11) have significantly higher attainment levels. In terms of size of the SES attainment gap for pre-reading, the difference in raw points is largest between the professional manual (I) and the semi/unskilled manual (IV/V) where the gap is slightly larger than the gender gap.

Home Environment Measures

The results indicate that the frequency with which parents said the child is 'taught' the alphabet at home compared with the never category shows a strong positive relationship with attainment in language, pre-reading and early number concepts. It should be noted that such alphabet 'teaching' would often be informal, through drawing attention to letters in a range of different contexts (e.g. books, adverts, magazines, food labels, etc). For pre-reading this difference is larger in terms of raw points than the gap for mother's highest qualifications and equivalent to half a standard deviation in the pre-reading outcome.

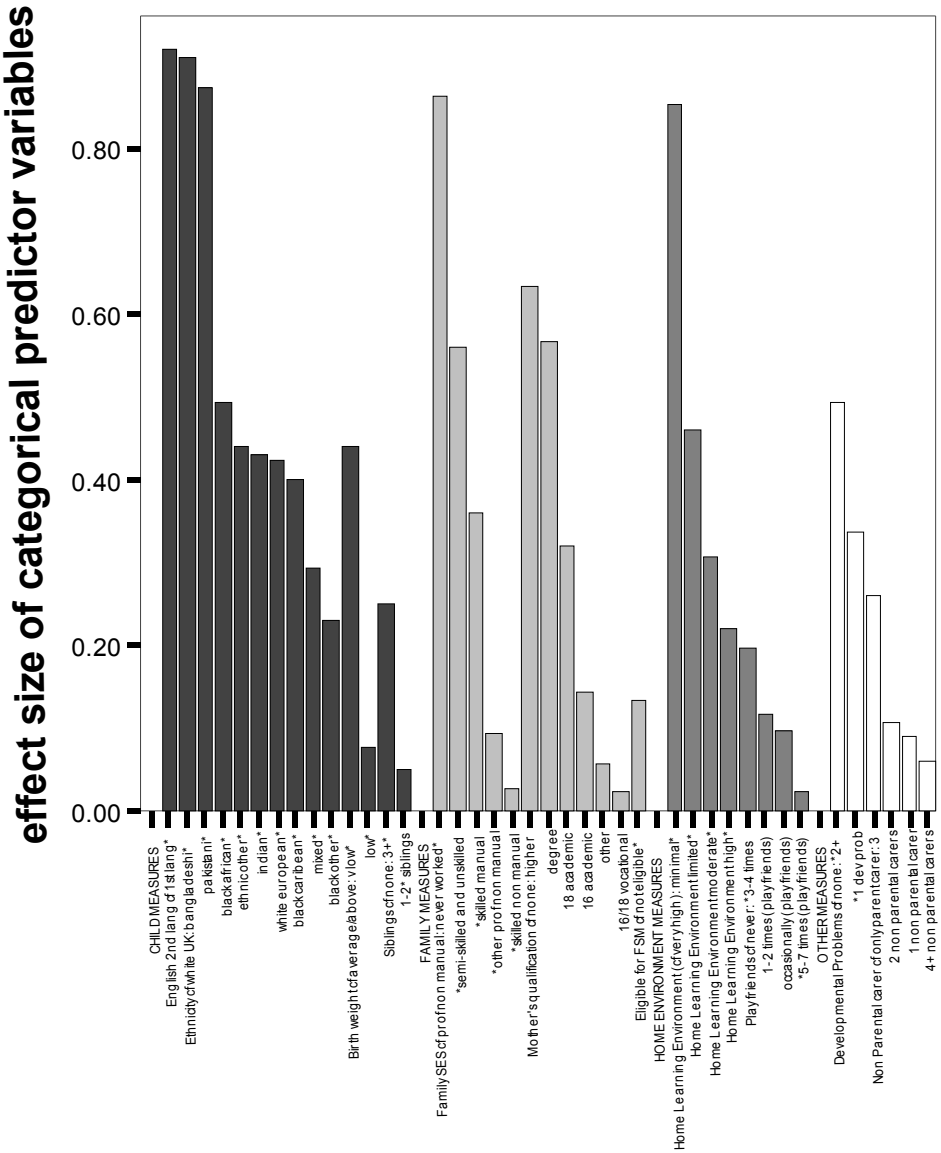
Library visits also show a small but significant positive impact on pre-reading, early number and language attainment. Frequency with which parents reported that they taught their child songs or nursery rhymes showed a significant positive impact on language scores at school entry controlling for other factors. Playing with letters/numbers is significant for pre-reading and early numbers concept outcomes. Additionally, the frequency with which the child paints and draws shows a positive relationship (compared with never/infrequent category) with attainment in the early numbers concept measure.

The frequency with which parents reported reading to the child is associated with higher scores in all five outcomes except spatial awareness/reasoning. Higher frequencies (daily, twice daily) showed the most positive impact compared with the group who reported they never or rarely read to their child.

Further analyses have been conducted using the home learning environment index which provides a summary based on the individual measures reported above. For further details of the relationship between this measure and children's cognitive development at entry to the study, age 3 plus years, see EPPE Technical Paper 7. Children's scores on this measure were divided into five groups; very high, high, moderate, limited and minimal.[22] These were tested in a contextualised model for language, as language was found to show the strongest relationship with child, family, and home learning environment background characteristics. Effect sizes were calculated to compare the strength of different groups of measures and are shown in Chart 2.1. It can be seen that the effect size for the home learning environment index (very high group compared with minimal) is large at 0.85. This is higher than that for family measures such as mother's qualification level and SES (except for the very small group whose parents had never worked (n=60) which had a similar effect size of 0.86). The chart also demonstrates the strength of the EAL effect (0.92) on language attainment and extent of ethnic differences, although again it must be noted that the numbers of children in many ethnic sub-groups are small.

[22] The number of children in these groups are as follows: very high n=335 (11.7%), high n=898 (31.4%), moderate n=667 (23.3%), limited n=591 (20.7%), minimal n=257 (9.0%).

Chart 2.1 Effect sizes for child, parent and home environment measures as predictors of language attainment at primary school entry



As a group, children whose parents reported that their children often play with friends at home (3 and above times a week) showed lower scores in the non-verbal sub-scales and in language to those who never played with friends at home. Children who played with friends 1 or 2 times a week showed no significant differences from those who never played with friends.

Other Measures

In terms of amount of pre-school centre experience, children who spent longer in pre-school (measured from start date of pre-school to date started reception) showed significantly higher attainment in pre-reading, early number concepts, language and non-verbal reasoning. Children who spent longer in primary school before taking the pre-reading assessment also attained better scores. This may indicate a strong emphasis on developing young children's pre-reading skills immediately on entry to primary school. It should be noted that the sample children were assessed within the first few weeks of starting primary school, usually in reception class, with the vast majority within the first half term (the 'cut off' period was within 10 weeks of entry).

There is strong evidence of an intake compositional effect for all cognitive outcomes. Children who attended pre-school settings where there was a higher proportion of children whose mothers have degrees, higher degrees or other professional qualifications attained more highly in entry to primary school assessments irrespective of their own characteristics.

Parents were asked in the interviews at entry to the study if their child had any developmental problems. As a group, children whose parents reported no developmental problems with their children showed higher pre-reading, early number concepts and language scores than children whose parents reported a developmental problem. Additionally, details about the number of non-parental carers a child had experienced before entering the study (e.g. relatives, usually grandmothers, childminders, etc.) was collected. This measure was tested in the contextualised models and showed a positive relationship for pre-reading and language (children with non-parent carers attaining higher scores in these outcomes than children with no non-parental carers). This suggests that additional stimulation from a range of adults may have some cognitive benefits.

The fully contextualised models test net impact of different child, parent and home learning environment measures while controlling for all other measures simultaneously and thus provides rigorous and conservative estimates of statistical significance for specific background characteristics. It does not imply that measures are not of educational or policy importance if they are not statistical predictors after control for other related measures. For example, parents' occupational status is related to mother's educational qualification level. Likewise, measures of home environment are inter-related. The contextualised model shows which set of measures, taken together, provides the best predictor of children's attainment and which measures show a specific impact over and above other influences.

Summary

The contextualised analyses provide important evidence concerning the strength of background influences on young children's cognitive attainments at the start of primary school. They illustrate that a range of child, parent and home environment factors continue to show a significant relationship with cognitive outcomes at age rising 5 years (echoing earlier findings reported at entry to pre-school). In addition the results show that time in pre-school also has an impact on cognitive attainment. Taken together the measures indicate that background characteristics are more strongly associated with language than with attainment in other areas. The findings also suggest pre-schools are most likely to vary in their impact on attainment in terms of pre-reading and early number concepts. In the next section further longitudinal value added models are presented which investigate children's cognitive progress and the influence of individual pre-schools on this.

Section 3: Children's Cognitive Progress Over the Pre-school Period: Results from Value Added Multilevel Analyses

In order to investigate the impact of individual pre-school centres on young children's cognitive progress, it is essential to have accurate baseline data about children's prior cognitive attainments so that subsequent gains can be measured. Only in this way will it be possible to establish whether children attending specific centres showed greater progress by entry to school. Additionally, it is also necessary to control for variations in the background characteristics of children attending different centres, as well as their prior attainments, in order to take adequate account of the influence of intake before comparisons of centre effectiveness are made.

This section presents the results of a value added analysis of cognitive progress over the pre-school period. The two types of value added models examined are *simple value added models* which controlling for children's prior attainment only, and *complex value added models which* control for children's prior attainment and, in addition, any significant child, family and home environment characteristics. Simple and complex value added models are also compared allowing the impact of background factors on progress, over and above the impact of prior attainment, to be ascertained. By comparing these results with models in Section 2 it is possible to explore the extent to which such factors influence progress over the pre-school period.

Research in the school effectiveness field (Goldstein et al, 1992; Mortimore et al, 1994; DFE, 1995; Strand, 2002; Tizard et al, 1988; Tymms et al, 1997) has shown that prior attainment is essential in the study of school effects and is a stronger predictor of future attainment than other pupil background indicators. The assessments chosen at entry to the EPPE study (age 3 years plus) were the BAS Ability Scales (Elliot et al, 1996) in Block Building, Verbal Comprehension, Picture Similarity and Naming Vocabulary.[23] These provide baseline measures for the value added analysis. From these four BAS ability scales, two composite measures were formed: *total verbal* (based on BAS language sub-scales of verbal comprehension and naming vocabulary) and *total non-verbal* (based on the BAS non verbal sub-scales block building and picture similarity).

It is important to note that the age of the child must be taken into account in value added models at both assessment points i.e. entry to the study and also at entry to primary school. The BAS assessments at entry to pre-school have been age standardised[24] to take account of the different ages at which children are assessed at pre-school entry (reflecting variations in centre entry policies and parents uptake of places). In terms of the outcome assessments made at entry to primary school (usually at the start of reception), the age in months of the child when the test was completed is controlled for in all the multilevel models. The impact of age was included separately in the models to illustrate its strength, given the considerable variations in the age children start school and the potential implications for policy and practice.

Simple value added models

The multilevel analyses of children's progress over the pre-school period reveal the existence of significant centre level variance, after controlling for both age in months at outcome assessment and age standardised prior attainment scores. Table 3.1 shows the results of the simple value-added model of child progress for the five cognitive outcomes, reporting the intra-centre correlation and the extent of variance at the pre-school centre level and at the child level.

[23] A contextualised analysis of children's cognitive attainment at entry to the EPPE study (using the BAS Ability Scales sub-scales) is reported in EPPE Technical Paper 2.

[24] Cres Fernandes from the NFER-NELSON was commissioned to standardise the prior attainment scores using the EPPE sample.

Table 3.1 Simple value added model[25] of progress showing pre-school centre and child level variance

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
Centre level variance: estimate (se)	**16.25 (2.54)**	**1.70 (0.32)**	**2.50 (0.45)**	**0.63 (0.16)**	**2.00 (0.48)**
Child level variance: estimate (se)	**88.78 (2.52)**	**17.11 (0.48)**	**23.48 (0.66)**	**13.55 (0.38)**	**34.45 (1.00)**
Intra-centre correlation	**0.155**	**0.099**	**0.096**	**0.045**	**0.055**
% Reduction in centre level variance	**58.26**	**68.24**	**82.89**	**74.83**	**76.68**
% Reduction in child level variance	**27.30**	**34.40**	**43.49**	**23.99**	**22.50**
% Reduction in total variance	**34.79**	**40.17**	**53.74**	**30.28**	**31.27**
Number of children (number of centres)	**2631 (141)**	**2631 (141)**	**2645 (141)**	**2646 (141)**	**2509 (140)**

The intra-centre correlation shows the extent to which unexplained variance in children's progress may be attributed to differences between the different pre-school settings. This gives an indication of variation in pre-school effectiveness (between the 141 individual pre-school centres in the EPPE sample). The results show that the size of the intra-school correlation varies between the five cognitive outcomes for the simple value added models. In descending order, the intra-centre correlation is largest for pre-reading, followed by early number concepts, language and is notably smaller for the 2 non-verbal BAS sub-scales (spatial awareness/reasoning and non-verbal reasoning). This indicates that pre-schools vary much less in their impact on the progress young children make in the non-verbal areas during their time in pre-school.

The intra-centre correlations for the simple value added models are smaller than those reported for the null models (i.e. with no explanatory variables included – see Table 2.1 in Section 2). When prior attainment and age are included in the simple value added multilevel models, differences in children's progress between pre-school centres reduces. The reduction is greatest for language and then spatial awareness/reasoning (a non-verbal sub-scale) i.e. the prior attainment measures of total verbal and total non-verbal show the strongest relationships with later measures of verbal and non-verbal attainment.

The simple value added models also reveal significant reductions in variation between pre-school settings for all outcomes after the inclusion of prior attainment and age. In terms of the language and non-verbal outcomes, controlling for prior attainment accounts for over three-quarters of the variation between pre-school centres. Therefore, it can be seen that the inclusion of prior attainment in the multilevel model has a marked impact on the centre-level variance, reflecting the extent of differences between centres in the prior ability of their intakes. The

[25] Controlling for age at outcome assessment and total verbal and non-verbal BAS age standardised scores at pre-school entry.

results for pre-reading and early number concepts show that prior attainment accounts for 58% and 68 % of the centre level variance respectively. The overall model fit is shown by the total variance accounted for. This ranges from 31% to 54%, being highest for the language outcome.

Complex value added models

Important relationships between child, family and home environment characteristics and children's attainment in the cognitive outcomes have been identified at entry to pre-school age 3 years plus[26] and also at school entry.[27] Subsequently, further multilevel analyses have been conducted to investigate the continuing impact of such measures on young children's progress over the pre-school period while taking account of the strong links with prior attainment. The results reveal that child, family and home environment factors continue to show a statistically significant relationship with children's progress over the pre-school period and account for additional variance at both the centre and child level. The impact of background factors can be seen by the reduction in total variance accounted for by the complex value added models (see Table 3.2) compared with simple value added models (see Table 3.1).

Table 3.2 Complex value added model[28] of progress showing pre-school centre and child level variance

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
Centre level variance: estimate (se)	**7.20 (1.43)**	**1.08 (0.24)**	**0.90 (0.26)**	**0.46 (0.15)**	**1.22 (0.38)**
Child level variance: estimate (se)	**78.62 (2.32)**	**16.28 (0.47)**	**21.85 (0.63)**	**13.28 (0.39)**	**33.47 (0.99)**
Intra-centre correlation	**0.084**	**0.062**	**0.040**	**0.033**	**0.035**
% Reduction in centre level variance	**81.05**	**79.21**	**93.78**	**81.46**	**85.72**
% Reduction in child level variance	**35.86**	**37.19**	**47.45**	**25.50**	**24.16**
% Reduction in total variance	**46.55**	**44.20**	**59.44**	**32.32**	**34.15**
Number of children (number of centres)	**2438 (141)**	**2501 (141)**	**2551 (141)**	**2509 (141)**	**2417 (140)**

The results show that the size of the intra school correlation varies between the five cognitive outcomes. It is notable that the inclusion of factors related to children's background has the strongest impact on progress for the pre-reading measure. In the simple value added model (accounting only for prior attainment and age at outcome testing), the intra-centre correlation for pre-reading is 0.155 (indicating that 15.5% of unexplained variance reflects centre influence). For the complex value added model, the equivalent percentage is 0.084 (indicating that 8.4% of unexplained variance lies between centres).[29] Similarly, there is also a reduction in the extent to which progress is associated with differences between pre-school centres (when background and home environment characteristics are controlled) for two other outcomes, early number

[26] described in Technical Paper 2.

[27] described in Section 2 of this paper.

[28] Controlling for age at outcome assessment, total verbal and non verbal BAS age standardised scores at pre-school entry and child, parent and home environment characteristics.

[29] While these figures may sound relatively small in percentage terms, they are larger than the impact of factors known to be strongly associated with attainment at school (for example, gender or free school meals).

concepts and language. The intra-centre correlations are only marginally higher for the simple (compared to the complex) value added non-verbal models indicating that other factors (i.e. child, family and home environment) do not impact greatly on children's progress in the non-verbal outcomes.
Comparisons of the reduction in centre-level variance for the simple and complex value added models show that child, family and home environment characteristics have a greater impact for specific outcomes. The inclusion of these factors for pre-reading accounts for a further 23% of the variation between pre-school centres. It can be seen that controlling for such measures has a marked impact on the centre-level variance (reflecting the extent of differences between centres in the characteristics of their intakes and their links with pre-reading attainment). The results for the other outcomes show that, in comparison with the pre-reading outcome, background measures have less of an impact on the centre-level variance adding between 7 to 11% to the centre level variance accounted for.

In summary, when exploring the impact of pre-school centres on children's progress, in addition to baseline measures of children's prior attainment, the EPPE study demonstrates the need to obtain good data about the child, parent and home environment. This allows proper control for differences between centres in the characteristics of the children they serve. Only when differences in intake are measured can valid comparisons be drawn. For all 5 outcomes (after controlling for prior attainment at entry to the EPPE study), a number of child, parent and home environment characteristics continue to show statistically significant relationships with progress over the pre-school period. Table C.6 in Appendix C summarises these results in a tabular format. The main findings in terms of intake characteristics for progress in each outcome are summarised below (details about the impact on cognitive attainments of each set of measures i.e. child, family and home environment are provided in Section 2 of this paper). In reporting differences it should be noted that the net impact of different factors is described and only differences that are statistically significant ($p<0.05$) are noted. The differences refer to findings made in comparisons of groups of children (e.g. girls compared with boys) and therefore refer to general trends that do not apply to all individuals within a group.

Tables C.1-C.5 in Appendix C show multilevel estimates and their associated standard errors for each outcome, whilst Charts D.1–D.4 in Appendix D give details of effect sizes for the pre-reading and early number concepts outcomes. It should be noted that effect sizes for some of the categorical measures of background apply to very small numbers of children (e.g. specific ethnic groups, children whose parents had never worked, those whose mothers had 'other professional' qualifications) and this should be recognised in interpreting the results.

Pre-reading progress (taking account of prior attainment)

Child measures:

- Girls made more progress in pre-reading than boys.
- Children who are older at school entry assessment made more progress in pre-reading.
- Children from Black Caribbean, Black African, Black Other, Indian and Mixed Heritage ethnic groups made more progress in pre-reading than the White UK ethnic group. It should be noted that these children had significantly lower prior attainment scores at entry to pre-school, and these findings suggest that they have made significant attainment gains in this outcome by primary school entry.
- Children from larger families (3 plus siblings) made less progress in pre-reading than singletons.
- EAL children made more progress in pre-reading than children whose first language is English. Again this group of children had shown significantly lower scores at entry to target pre-school and this result suggests EAL children made significant progress towards narrowing the attainment gap in comparison with other children.
- Children with low birth weight made less progress in pre-reading than children classified as normal/above normal birth weight.

Family measures:

- Children not eligible for FSM made more progress in pre-reading than the group who were identified as eligible for FSM. FSM provides a crude measure of low family income measured at entry to primary school but is likely to identify children whose families experienced low incomes during the pre-school period.
- Compared with children whose mothers have no qualifications, children whose mothers have higher qualification levels (18 year academic and above i.e. degree, higher degree or other qualifications) all made more progress in pre-reading, with those whose mothers have higher degrees recording the greatest gains.
- Children from families where the parents' highest SES is professional Class I made more progress in pre-reading than children from families from other SES groups. The differences were largest for semi and unskilled manual IV/V and the never employed groups.

Home environment measures:

- Children whose parents reported that their children played with letters and numbers more frequently made greater progress in pre-reading.
- Children whose parents reported encouraging their children to learn the alphabet made more progress in pre-reading, with those children whose parents encourage them frequently (i.e. 3 times or more a week) recording the most positive impact.

Duration of pre-school and reception experience:

- Children who changed pre-school centre during the study made less progress in pre-reading than those who remained in the target pre-school until entry to primary school. This result may indicate that change of centre has an adverse impact. Alternatively, it may be that parents who are dissatisfied with a pre-school centre, or who want a place offering more sessions are more likely to move their child.
- Children who spent longer in pre-school (measured in months from date BAS assessments taken at entry to pre-school or age 3 to date started reception) made more progress in pre-reading.[30]
- Children who spent longer in reception before taking the pre-reading assessment made more progress in pre-reading (children were assessed within ten weeks of starting reception). This suggests that reception teachers lay much emphasis on pre-reading skills when children first start school.

Composition of intake measures:

- Children attending centres where there were a higher proportion of children whose mothers have more educational qualifications (degrees, higher degrees or other professional qualifications) made more progress in pre-reading.
- Children attending centres where there were a higher proportion of children with below average attainment (children with a BAS General Cognitive Ability (GCA) score at entry to pre-school 1 standard deviation below the mean[31]) made less progress in pre-reading.

In terms of strength of influences, the results point to the importance of measures of home learning environment and mother's highest qualification level. The positive effects for specific ethnic groups are also strong (see also Table C.1 in Appendix C and Charts D.1 and D.2 on effect sizes in Appendix D).

[30] Note that the number of months of pre-school attended before the child entered the EPPE study is not included in this duration measure. A separate 'duration' measure of amount of time in pre-school prior to entering the study was tested in the simple value added models and was not significant in terms of progress in any of the 5 outcomes (note that this 'duration' measure is correlated with prior attainment).

[31] Approximately 16% of the values in a normal distribution lie below 1 standard deviation of the sample mean.

Early number concepts progress (taking account of prior attainment)

Child measures:
- Girls made more progress in early number concepts than boys.
- Children who are older at school entry assessment made more progress in early number concepts.
- Children with very low birth weight made less progress in early number concepts than children classified as normal/above normal birth weight.[32]

Family measures:
- Children whose mothers have academic qualifications, especially at age 16 and 18, made more progress in early number concepts than children whose mothers have no qualifications.[33]
- Children from families where the parents' highest SES is classified as either non manual III or semi-skilled manual IV made less progress in early number concepts than children from families where the highest SES is professional Class I.

Home environment measures:
- Children whose parents reported that their child paints and draw at home made more progress in early number concepts than children whose parents said that their child did not engage in these activities.
- Children whose parents reported that their child played with letters and numbers daily made more progress in early number concepts than children whose parents reported that their child never played with letters and numbers.
- Children whose parents reported frequently encouraging their children to learn the alphabet made more progress in early number concepts than children whose parents did not report that they encouraged their child to learn the alphabet.

Developmental measures:
- Children whose parents reported no developmental problems for their child made more progress in early number concepts than children whose parents reported a developmental problem.

Duration of pre-school measures:
- Children who spent longer in pre-school, measured in months from date of BAS assessments taken at entry to the study until primary school entry, made more progress in early number concepts.

Composition of intake measures:
- Children attending pre-school centres where there were a higher proportion of children whose mothers have degrees, higher degrees or other professional qualifications made more progress in early number concepts.

There are no statistically significant differences related to EAL status or number of siblings for children's progress over the pre-school period in early number concepts. In addition, in contrast to findings for pre-reading, there was no evidence that children who changed pre-school centre made less progress in early number concepts over the pre-school period. However, the change measure is retained in the statistical models for consistency with other outcomes because it marginally improves the model fit and is important from a theoretical perspective for identifying

[32] Again this is in line with findings reported by Richards et al, 2001 on the influence of low birthweight noted earlier in relation to attainment.

[33] Note that when the composition of intake measure 'percent of mothers at the centre level with degrees, higher degrees and other professional qualifications' is included in the model, the impact of degrees and higher degrees at the child level becomes non significant for early number concepts.

individual centre effects. No significant ethnic differences in progress for early number concepts were found, although the results for the Pakistani group were negative, indicating poorer progress, and just failed to reach significance.

In terms of strength of child, family and home learning environment measures, the results indicate that such factors have weaker effects on progress in early number than in pre-reading skills or language as can be seen in terms of total variance explained (see Tables 3.1 and 3.2) and from Tables C.2 in Appendix C and effect size Charts D.3 and D.4 in Appendix D.

Language progress (controlling for prior attainment)

Child measures:
- Children who are older at time of outcome assessment made more progress in language.
- Children from the following ethnic groups – Black Caribbean and Pakistani – made smaller gains in terms of progress in language than the White UK ethnic group. No other ethnic differences were statistically significant.
- Children from larger families (3 plus siblings) made less progress in language than singletons (only children).
- Children who speak English as an additional language made less progress in language than children whose first language is English.

Family measures:
- Compared with children whose mothers have no qualifications, children whose mothers have higher qualification levels (i.e. degree and higher degree) made more progress in language.
- Children from families where the highest SES is semi skilled manual IV or whose parents have never worked made less progress in language than children from families where the highest social class of occupation is professional Class I.

Home environment measures:
- Children whose parents reported reading to them daily made more progress in language than children whose parents read to them less frequently.
- Children whose parents reported taking their child to the library made greater gains in language progress than children whose parents said they never visit the library, with those whose parents said they visited fortnightly recording a significant positive impact.
- Children whose parents reported encouraging their child to learn songs, poems or nursery rhymes made more progress in language, with those children who said this happened more frequently (3-5 times a week) recording a significant positive impact.
- Children whose parents reported that their child often played with friends at home (3 plus times a week) made less progress in language than others. Children who had friends to play less often (once or twice a week) showed similar progress in language to those who never played with friends at home. This may suggest that children who spend a lot of time playing with other children at home have reduced opportunities for interaction with adults, and adult interactions may have a stronger impact on language acquisition.

Duration of pre-school measures:
- Children who spent longer in pre-school (measured from date BAS assessments taken at entry to the study to start of primary school) made more progress in language.

Composition of intake measures:
- Children attending pre-school centres where there were a higher proportion of children whose mothers had degrees, higher degrees or other qualifications made more progress in language.

There were no significant gender differences in language progress, in contrast to the findings for pre-reading. Birth weight also showed no significant association with language progress (again in contrast to the significant link with gains for both pre-reading and early number concepts). The

measure of social disadvantage (receipt of free school meals) was also not found to be significantly associated with progress in language. There was no evidence that children who changed centre during the EPPE study period made less progress in their language development. (Note that despite statistical non-significance for language, the change measure is retained as it marginally improves the model fit and is important from a theoretical perspective in identifying individual centre effects.)

In terms of strength of child, family and home learning environment influences on language progress their combined impact accounts for more of the variance than for early number concepts but not as much as for pre-reading. Higher levels of mother's qualification and family SES and frequency of reading (daily or twice daily) all show fairly strong positive effects (see Table C.3 in Appendix C). The poorer progress rates for language development for some ethnic groups are in contrast to the strong positive gains identified for pre-reading progress.

Non-verbal progress: in terms of BAS Non-verbal reasoning (controlling for prior attainment)

Child measures:
- Girls made more progress in non-verbal reasoning than boys.
- Children who are older at time of outcome assessment made more progress in non-verbal reasoning.
- Children from the Black Caribbean ethnic group made more progress in non-verbal reasoning than the White UK ethnic group.

Family measures:
- Children not eligible for FSM made more progress in non-verbal reasoning than children eligible for FSM.
- Compared with children whose mothers have no qualifications, children whose mothers have degrees made greater gains in non-verbal reasoning.
- Children from families where the parents' highest SES is unskilled manual V or have never worked made less progress in non-verbal reasoning than children from families where the parents' highest SES is professional Class I.

Duration of pre-school measures:
- As a group, children who spent longer in pre-school (measured in months from date BAS assessments were taken at entry to study to date outcome assessment were taken at end of time in pre-school) made more progress in non-verbal reasoning.

In terms of spatial awareness/reasoning (i.e. BAS pattern construction) (controlling for prior attainment)

Child measures:
- Children who are older at school entry assessment made more progress in spatial awareness/reasoning.
- Children from the Bangladeshi ethnic group made more progress in spatial awareness/ reasoning than the White UK ethnic group.
- Children with very low birth weight made less progress in spatial awareness/reasoning than children classified as normal/above normal birth weight.

Family measures:
- Compared with children whose mothers have no qualifications, children whose mothers have higher qualification levels (16 year academic and above i.e. 18 year academic, degree and higher degree) show greater gains in terms of spatial awareness / reasoning progress, with those whose mothers have degrees or higher degrees recording the most positive impact.

Duration of pre-school measures:

- Children who spent longer in pre-school (measured in months from date BAS assessments taken at entry to the study to date starting primary school) made more progress in spatial awareness/reasoning.

Composition of intake measures:

- Children attending pre-school centres where there was a higher proportion of mothers with degrees, higher degrees or other qualifications made greater gains in terms of spatial awareness/reasoning progress.

None of the home environment measures showed a relationship to children's progress over the pre-school period for the spatial awareness/reasoning (pattern construction) and non-verbal reasoning (picture similarities) at school entry. Likewise neither of the factors number of siblings or a change in pre-school during the EPPE study period were statistically significant after controlling for the influence of other characteristics (however, as for previous outcomes, the change measure is retained in the model to facilitate comparisons and enable the calculation of centre effects). It is important to note that the age effect is stronger for the spatial awareness/ reasoning and non-verbal reasoning outcomes and early number concepts than for the pre-reading and language outcomes. This has implications for reception teaching, given the varied ages at which young children start primary school. The results concerning the impact of specific child, family and home environment factors on progress in spatial awareness/reasoning and non-verbal reasoning (i.e. the two BAS non-verbal sub scales) during the pre-school period were similar. Taken together such factors (apart from age) show much weaker relationships with young children's progress in non-verbal outcomes than in the other cognitive measures reported earlier. This can be seen from the percent of centre and of total variance explained (shown in Table 3.2).

Differences Between Individual Pre-School Centres in their Effects on Child Outcomes

Using an 'educational effectiveness' design based on multilevel modelling, the progress of EPPE children has been tracked to estimate the impact of individual centres on children's cognitive progress over the pre-school period. As seen earlier in this report, child characteristics and social background was taken into account, along with the 'home learning environment' provided by parents.

Centres that are more or less effective in promoting children's progress (i.e. outliers) have been identified by categorising the value added residuals for the five outcome measures for each of the 141 centres in the study. Pre-school centre effects significantly above/below expectation at the 95% confidence limit are identified by calculating confidence intervals for each value added residual (value added residual +/- 1.96 standard error). If the confidence intervals for a value added residual do not overlap zero,[34] the value added residual is significantly different either above or below expectation and identified as an outlier.

In studies of institutional effects (particularly where the number of children in studies of individual institutions are small) it is common for the majority of value added residuals to have 95% confidence intervals that overlap zero, suggesting centre effects on children's progress are not significantly different from zero (or, in other words, children make progress in line with that predicted). It is also possible to classify centre effects either above or below expectation by calculating less stringent confidence intervals at the 68% significance level for the value added residuals (value added residual +/- 1 standard error). Table 3.3 summaries centre effects for the 141 pre-school centres. The results show that there is greater variation in pre-school effects for children's pre-reading progress and less variation for their language and non-verbal progress. For example, 16 centres (11.4%) of the 141 included in the analysis of pre-reading progress were identified as significant outliers either above or below expectation at the 95% confidence intervals. The equivalent number of significant outliers for early number concepts is 12 centres (8.5%). For the other cognitive outcomes (language, non-verbal reasoning and spatial awareness/reasoning), there are far fewer significant outliers (approx 2-4%). It is possible that this finding of more outliers for progress in some outcomes reflects differences in the aims and the curriculum emphasis given to areas such as pre-reading and early number skills in certain pre-school settings. It may also reflect differences in environmental quality. It should be noted that the estimation of individual centre effects is made after control for the impact of duration of pre-school centre experience. If this were not included in the multilevel models the variance at the centre level would increase.

Table 3.3 Summary of pre-school centre effects showing number of pre-schools in each category

Centre Effectiveness Category	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning[35]
Above expectation (95% significance)	10 (7.1%)	7 (5.0%)	1 (0.7%)	1 (0.7%)	3 (2.1%)
Above expectation (68% significance)	18 (12.8%)	20 (14.2%)	16 (11.3%)	13 (9.2%)	8 (5.7%)
As expected	83 (58.9%)	95 (67.4%)	108 (76.6%)	113 (80.1%)	118 (84.3%)
Below expectation (68% significance)	24 (17.0%)	14 (10.0%)	14 (9.9%)	12 (8.5%)	9 (6.4%)
Below expectation (95% significance)	6 (4.3%)	5 (3.5%)	2 (1.4%)	2 (1.4%)	2 (1.4%)

percentages given in brackets

[34] The average effect predicted for the whole sample based on child, parent and home environment characteristics and prior attainment is designed to be zero.

[35] For spatial awareness/reasoning, only 140 pre-school settings were included in the analysis due to missing data.

It must be noted that the number of children in the multilevel analysis at the centre level is a crucial factor that affects the identification of statistically significant outliers. Where the number of children is small (as tends to be the case in many pre-school settings), the confidence limits for value added residual estimates of individual centre effects are wider. Therefore, as most pre-school centres in the EPPE study have small numbers of children in the study, the number of centres identified as outliers is likely to be a fairly conservative estimate of the extent of 'real' differences. Moreover, as the mean numbers in the EPPE sample (see Table 1.1 in Section 1) are largest for nursery schools, integrated centres (i.e. combined centres) and nursery classes, the chances of identifying statistically significant differences are somewhat higher for these types of provision.–

Correlations were calculated to test the strength of relationships between centres' effects on different cognitive outcomes. The results in Table 3.4 show there are only weak, though usually statistically significant, positive associations between residual estimates of centre effects on progress in different cognitive outcomes over the pre-school period. The strongest correlation is between effects on early number concepts and non-verbal reasoning progress. In addition, Tables 3.5–3.7 show the relationships between the 141 pre-school centres value added residuals for sets of outcomes. For example, the cross tabulation of pre-school centre effects for the language and early numbers concepts outcomes (Table 3.7) reveals that 57% of the pre-school centres in the EPPE sample have the same 'effectiveness' category for the two outcomes. In the other centres, different levels of effectiveness for the two outcomes are found. This demonstrates the extent of internal variations in EPPE pre-school centres' effectiveness across the five cognitive outcomes.

Table 3.4 Correlations between pre-school centre effects across five cognitive outcomes

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
Pre-reading	**1.00****	**0.33****	**0.32****	**0.10**	**0.24****
Early number concepts		**1.00****	**0.33****	**0.42****	**0.30****
Language			**1.00****	**0.33****	**0.21***
Non-verbal reasoning				**1.00****	**0.06**

** statistically significant at the 0.01 level *statistically significant at the 0.05 level

Table 3.5 Cross tabulation of pre-school centre effects for the outcomes pre-reading and early number concepts

Early number concepts / Pre-reading	Above expectation (95% significance)	Above expectation (68% significance)	As expected	Below expectation (68% significance)	Below expectation (95% significance)
Above expectation (95% significance)		4 (2.8%)	6 (4.3%)		
Above expectation (68% significance)	3 (2.1%)	2 (1.4%)	12 (8.5%)	1 (0.7%)	
As expected	4 (2.8%)	11 (7.8%)	56 (39.7%)	9 (6.3%)	3 (2.1%)
Below expectation (68% significance)		2 (1.4%)	17 (12.0%)	4 (2.8%)	1 (0.7%)
Below expectation (95% significance)		1 (0.7%)	4 (2.8%)		1 (0.7%)

Percentages given in brackets

Table 3.6 Cross tabulation of pre-school centre effects for the outcomes pre-reading and language

Language / Pre-reading	Above expectation (95% significance)	Above expectation (68% significance)	As expected	Below expectation (68% significance)	Below expectation (95% significance)
Above expectation (95% significance)		1 (0.7%)	9 (6.4%)		
Above expectation (68% significance)	1 (0.7%)	3 (2.1%)	13 (9.2%)	1 (0.7%)	
As expected		11 (7.8%)	62 (44.0%)	10 (7.1%)	
Below expectation (68% significance)		1 (0.7%)	20 (14.2%)	3 (2.1%)	
Below expectation (95% significance)			4 (2.8%)		2 (1.4%)

Percentages given in brackets

Table 3.7 Cross tabulation of pre-school centre effects for the outcomes language and early number concepts

Early Number Concepts / Language	Above expectation (95% significance)	Above expectation (68% significance)	As expected	Below expectation (68% significance)	Below expectation (95% significance)
Above expectation (95% significance)	1 (0.7%)				
Above expectation (68% significance)	3 (2.1%)	3 (2.1%)	10 (7.1%)		
As expected	2 (1.4%)	17 (12.0%)	74 (52.5%)	12 (8.6%)	3 (2.1%)
Below expectation (68% significance)	1 (0.7%)		10 (7.1%)	2 (1.4%)	1 (0.7%)
Below expectation (95% significance)			1 (0.7%)		1 (0.7%)

Percentages given in brackets

Internal variations in pre-school centres' effectiveness across the five cognitive outcomes can also be examined by an exploration of the profiles of the pre-school centres in terms of the value added residual categories. For the 141 pre-school settings, 33 centres (23.4%) are performing broadly as expected (compared to other pre-school centres in the sample) across all areas of cognitive progress assessed, when intake differences are controlled. In other words, there are no significant internal variations in these centres' effectiveness.

The remaining 108 centres (76.6%) are performing above and/or below expectation (at either the 68 or 95% confidence levels) in one or more of the outcome measures. Out of these 108

centres, 31 centres are performing significantly either above or below expectation at the more stringent 95% level for one or more of the outcome measures. Table 3.8 shows that the majority of these 31 centres are performing statistically significantly above or below expectation for only one cognitive outcome. None of the centres are performing either above or below expectation at the 95% significance level for 4 or 5 cognitive outcomes. In general, the pre-school centres show either a broadly positive or a broadly negative centre profile. To illustrate this Table 3.9 provides an example of two contrasting centre profiles. The individual pre-school centre denoted by **X** has a broadly positive profile with children performing above expectation for three out of the five outcomes. By contrast, three of the value added residuals are below expectation for pre-school centre **Y,** which has a broadly negative profile.

Table 3.8 Number of outlier pre-school centres with effects either above or below expectation at the 95% significance level for 1-5 outcomes

	1 outcome	2 outcomes	3 outcomes	4 outcomes	5 outcomes
Above expectation (95% significance)	**13**	**2**	**1**	**0**	**0**
Below expectation (95% significance)	**12**	**2**	**1**	**0**	**0**

Table 3.9 Example of pre-school centre profiles

	Pre-Reading	Early Number Concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
Above expectation (95% significance)	**X**				
Above expectation (68% significance)			**X**	**X**	
As expected	**Y**	**X**			**X Y**
Below expectation (68% significance)		**Y**		**Y**	
Below expectation (95% significance)			**Y**		

X denotes a broadly positive value added residual category centre profile

Y denotes a largely negative value added residual category centre profile

However, a small number of centres (11 in total) were identified with a mixed profile of value added residuals across the five outcome measures (i.e. are performing above expectation in at least one outcome and below expectation in at least one outcome). Table 3.10 illustrates two examples of pre-school centres in the EPPE sample with a mixed profile of cognitive value added residuals. As a group, children in Centre **A** made significant progress in two cognitive outcomes; however, by contrast, the same children made less progress in one outcome. The pre-school centre represented by **B** is another example of a centre with a mixed centre effect profile with children making progress below expectation in two outcomes and above expectation in one outcome (the children making progress in line with that expected given their prior attainment and characteristics in the other two outcomes). It is important to note that no centres performed significantly above expectation at the 95% level in one outcome AND significantly below expectation also at the 95% level in another outcome.

Table 3.10 Examples of two 'mixed' centre profiles

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
Above expectation (95% significance)	**A**				
Above expectation (68% significance)	**B**		**A**		
As expected		**A**	**B**		**A B**
Below expectation (68% significance)		**B**		**A**	
Below expectation (95% significance)				**B**	

A and **B** denote mixed value added residual category centre profiles

In EPPE Technical Paper 8b, pre-school centre profiles are examined in a similar way using the results of the multilevel value added analysis of social behavioural outcomes. Further exploration of centre profiles examining value added residuals from both the cognitive and social behavioural outcomes will be reported in future papers. These will investigate whether centres with a broadly positive profile for cognitive outcomes also have a positive profile for social behavioural outcomes. Using the pre-school centre profiles from both cognitive and social behavioural value added analyses, a sample of pre-school settings ranging from average to very effective was selected for detailed case study analysis (see EPPE Technical Paper 10).

It can be concluded that pre-school centres in the EPPE sample differ in their impact on children's cognitive progress, but much internal variation also exists when different outcome measures are used. Some centres are found to have a particular strength and others an area of apparent weakness. The next section moves on to establish the extent to which it is possible to account for some of the variation in young children's progress by measures of centre processes and quality.

Section 4: Accounting for Pre-school Centre Effects on Children's Cognitive Progress

An important aim of the EPPE research is to establish whether particular features of pre-school settings are related to children's progress or social behavioural development. In this paper, the focus is on cognitive outcomes. Observational data on the quality of pre-school centres environments was obtained using the Early Childhood Environment Rating Scale and the English Extension (ECERS-R and ECERS-E) and Caregiver Interaction Scale instruments (for further details see EPPE Technical Paper 6a). In addition, type of pre-school setting is an important feature given diversity in pre-school provision in England. The EPPE study therefore also has the further aim of examining whether there are systematic variations in centre effectiveness for the six types of provision included in the sample (141) of centres. Given the links between quality and type of provision identified elsewhere (see EPPE Technical Papers 5 and 6), the relationships between staff qualification levels, staff ratios and children's cognitive progress are also explored.

For each of the five cognitive outcomes collected at school entry, a number of process measures related to pre-school experience were tested by addition to the complex value added models to explore their impact on progress. It should be noted that the multilevel models adopted control for age at outcome assessment points, change of centre, standardised prior attainment and all measures found to be significant predictors in the complex value added models of progress described in Section 3 of this report.

Pre-School Type
The five regions in EPPE were strategically chosen to represent urban, suburban, and rural areas and also to include neighbourhoods with social and ethnic diversity. All local authorities in the EPPE sample were divided into five sampling areas, usually geographic divisions that already existed. Official lists of playgroups, nursery classes, nursery schools, private day nurseries, social services/voluntary day nurseries, and nursery schools combining care and education were obtained with the help of the local early years co-ordinators in every authority. Within each sampling area, one of each type of provision was randomly selected, yielding approximately 25 centres of various types in each region. Some over- and under-sampling occurred in each category of provision because not all authorities had sufficient numbers of local authority day nurseries.

Summary of the different types of provision
For the main analysis pre-schools were divided into six types.

1. Local Education Authority nursery classes (n=25)
   These are part of primary schools, have an adult:child ratio of 1:13 (one in every two adults is normally a 4-year graduate qualified teacher and the other adult usually has had 2 years childcare training) and usually offer only half-day sessions in term time, 5 days/week.

2. Voluntary playgroups and/or pre-schools (n=34)
   These have an adult:child ratio of 1:8 (training of adults is variable from none to graduate level. The most common type of training is based on short Pre-school Learning Alliance courses). All offer sessional provision in term time. Many children attend fewer then 5 days/week. Playgroups usually have fewer resources (facilities, materials and sole use of space) than other types of centres.

3. Private day nurseries (n=31)
   These have an adult:child ratio of 1:8 (normally the adults have a two year childcare training, but some have less training). All offer full day care for payment.

4. Local authority (day care) centres (n=24)
   These came from the social services day care tradition, although in recent years many have come under the authority of the LEA. Thirteen in this group combined care and education with one teacher per centre or a peripatetic teacher shared with other centres. 11 centres have not officially incorporated education into care. The ratio is 1:8 (normally the adults have a two year childcare training, the combined centres have a small input from a teacher), and all offer full day care.

5. Nursery schools (n=20)
   These are 'traditional' nursery schools under the LEA with adult:child ratios of 1:13, (the headteacher would be a 4-year graduate qualified teacher with an early years background, other staff would have similar training to nursery classes employees, usually a trained teacher and classroom assistant in each class), usually offering half-day provision. One in this group was an 'Early Excellence Centre'.

6. Integrated centres (also known as combined centres). In the sample these are former nursery schools combining education and care (n=7)
   These are similar to nursery schools but have developed their provision of extended care to include full day care and parent involvement. They would have statutory adult:child ratio of 1:13, although many negotiated more generous ratios reflecting their additional care provision (staffing would be the same as nursery schools for the over 3s). Even though these centres were chosen as a stratified random sample four in this group were 'Early Excellence Centres'.

Multilevel analyses were used to test the impact of pre-school type on children's cognitive progress over the pre-school period. The full range of type of pre-school comparisons[36] for the five cognitive outcomes are shown in Table 4.1 (results for spatial awareness/reasoning are omitted as no significant differences between types of provision were found in the multilevel analysis). Only significant effects between types of pre-schools are reported with *positive* denoting a positive significant effect whilst *negative* shows a negative significant effect. For example, in terms of early number concepts, the analyses shows that there is a statistically negative effect on progress associated with children who attended nursery classes compared with children who attended integrated centres. Likewise there is a significant negative effect for children attending LA day care. These effects are identified after controlling for differences in intake using a wide range of child, parent, family, home environment and other pre-school characteristics, as well as prior attainment.

The size of the significant type of pre-school estimates are moderate, ranging between 0.69 and 2.30 raw score points, i.e. children who attended nursery schools on average made significantly more progress in non-verbal reasoning by 0.69 score points compared with children who attended nursery classes. Similarly, children who attended private day nurseries made significantly more progress in pre-reading by 2.30 raw score points compared to children from LA day care nurseries.[37]

[36] For the variable 'types of provision', the analysis has been repeated using each type of provision as the comparison group. In this way it is possible to establish with greater certainty the extent to which progress varies for children attending different types of provision.

[37] The mean and standard deviation for these outcomes are as follows: pre-reading mean 21.57 sd 12.67, non-verbal reasoning mean 22.38 sd 4.54

Table 4.1 Impact of type of provision on children's cognitive progress (using the complex value added models)

	Pre-reading	Early number concepts	Language	Non-verbal reasoning
Compared to integrated centres				
Nursery classes		**negative**		**negative**
Playgroups				**negative**
Private day nurseries				
LA day care		**negative**	**negative**	
Nursery schools				
Compared to nursery classes				
Playgroups		**positive** #		
Private day nurseries				
LA day care	**negative**			
Nursery schools		**positive**		**positive**
Integrated centres		**positive**		**positive**
Compared to playgroups				
Nursery classes				
Private day nurseries				
LA day care			**negative**	
Nursery schools				
Integrated centres				**positive**
Compared to private day nurseries				
Nursery classes				
Playgroups				
LA day care	**negative**		**negative**	
Nursery schools				
Integrated centres				
Compared to LA day care				
Nursery classes	**positive**#			
Playgroups			**positive**	
Private day nurseries	**positive**		**positive**	
Nursery schools		**positive**		
Integrated centres		**positive**	**positive**	
Compared to nursery schools				
Nursery classes		**negative**		**negative**
Playgroups				
Private day nurseries				
LA day care		**negative**		
Integrated centres				

just failed to reach statistical significance at 0.05 level

The most consistent findings for pre-school type are that children in local authority day nurseries made less gains in pre-reading, early number concepts and language in comparison to all other types of provision. The difference is statistically significant when children in local authorities are compared to children in:

- nursery classes and private day nurseries for the pre-reading outcome
- nursery schools and integrated centres (i.e. combined centres) for the early number concepts outcome
- playgroups, private day nurseries and integrated centres for the language outcome.

There are indications that children in integrated centres generally made greater cognitive gains compared with children in other types of provision, except nursery schools. This is the case for all cognitive outcomes except spatial awareness/reasoning. The lack of significant difference between the categories integrated provision and nursery schools indicates that these two forms

of provision are not distinguishable in terms of their impact on children's cognitive progress. In terms of statistically significant differences, children in integrated centres made more progress in:

- early number concepts than children in nursery classes and local authority daycare
- language than children in local authority daycare
- non-verbal reasoning than children in nursery classes and playgroups.

Furthermore, the multilevel analyses of children's cognitive progress shows that overall children made less progress in nursery classes compared to those children in nursery schools in the two pictorial reasoning ability outcomes (i.e. early number concepts and non-verbal reasoning).

It should be noted that there are major difficulties in identifying any clear effects for playgroups because there is a confounding of change and type of pre-school.[38] When change is not included in the model playgroups show a negative impact verging on significance compared with nursery classes for the pre-reading outcome. However, when the impact of a child changing their centre is controlled, a positive impact verging on significance for playgroups on early number concepts is recorded. As noted previously, in terms of the language outcome, children in playgroups made more progress than children in local authority daycare. The strong relationship between change of centre and type of provision make it difficult to identify effects for playgroups reliably.

Children in private day nurseries made significantly more progress than children in local day authority nurseries for pre-reading and language. These effects are identified after taking account of the compositional effect measured by the proportion of EPPE children whose mothers had higher level (degree or above) qualifications at the centre level (an indicator of advantaged composition). As shown in Table 4.2, the intakes to private day nurseries tend to be more advantaged in this respect with much higher concentrations of mother's with degrees or above. In contrast, local authority day care, integrated centres and nursery classes on average have higher concentrations of children whose mother's have no qualifications than other forms of provision. If compositional effects are not controlled, positive effects for the category private day nurseries are stronger for these outcomes.

Table 4.2 shows the mean percentage of children whose mothers have a degree / no qualifications

	Full EPPE sample n=141	Nursery class n=25	Playgroup n=34	Private day nursery n=31	LA day care n=24	Nursery school n=20	Integrated centre n=7
% of children in a centre whose mothers have no qualifications	17.03% (14.22)	22.77% (16.41)	17.25% (12.36)	4.85% (6.61)	26.76% (15.43)	14.65% (7.71)	22.86% (11.77)
% of children in a centre whose mothers have a degree or above	18.94 (20.01)	12.83% (14.60)	11.46% (10.34)	38.73% (27.98)	15.88% (14.54)	13.82% (11.30)	14.48% (11.12)

Standard deviation given in brackets

If such compositional variables are not taken into account, private day nurseries also show a significant positive impact on early number concepts and spatial awareness/reasoning (pattern construction) compared to nursery classes.

The presence of a large proportion of advantaged children (in terms of mother's educational level) in a private day nursery means that any individual child will tend to have more peer interaction with children who have higher cognitive attainment on average. This experience may foster the further development of such skills. Such a compositional effect may also influence staff behaviour in ways likely to foster children's development (perhaps through activities and

[38] See Table 1.2 in Section 1 illustrating number and percentage of children changing pre-school centre before school entry by type of provision.

expectations). The results indicate that a more advantaged composition tends to be beneficial to all children in any individual centre, irrespective of type.

There is also considerable variation in the effectiveness of individual centres within each type of provision. Centres performing statistically above and below expectation (statistical outliers) were identified in each type of provision. It is found that more of the positive centre outliers for pre-reading were private day nurseries (after controlling for the compositional measure). For early number concepts more of the positive outliers were nursery schools and integrated centres (i.e. combined centres), while more of the negative outliers were local authority day nurseries and nursery classes.

In addition, the mean (average) pre-school centre effects (i.e. value added residuals) by pre-school type can be examined (see Table 4.3). The results generally mirror the findings above. Results for spatial awareness are omitted as no significant differences between types of provision were found in the multilevel analyses.

Table 4.3 Mean pre-school centre effects by pre-school type

	Pre-reading	Early number concepts	Language	Non-verbal reasoning
Nursery classes	**0.34**	**-0.32**	**-0.04**	**-0.16**
Playgroups	**-0.35**	**0.08**	**0.06**	**-0.07**
Private day nurseries	**0.42**	**0.05**	**0.07**	**0.04**
LA day care	**-0.65**	**-0.25**	**-0.25**	**0.02**
Nursery schools	**0.10**	**0.28**	**0.04**	**0.12**
Integrated centres	**0.61**	**0.59**	**0.27**	**0.36**

Note that the average predicted for the whole sample based on child, parent and home environment characteristics and prior attainment is designed to be zero.

To summarise the effects of type of pre-school on cognitive progress, integrated provision (i.e. combined centres) was associated with greater progress in several areas (early number, language and non-verbal), even after controlling for prior attainment, and child, family and home background influences and compositional effects. Local authority day care nurseries by contrast were associated with poorer cognitive progress in language, pre-reading and early number. In addition:

- nursery schools showed positive results compared with nursery classes in early number and non-verbal outcomes
- nursery classes showed better pre-reading results than local authority centres
- playgroups showed better results for language than local authority centres.

Quality Characteristics (in terms of ECERS-R and ECERS-E)

Two rating scales were used in EPPE to assess the quality of pedagogy, curriculum and resources. The American Early Childhood Environment Rating Scale (ECERS-R) (Harms et al, 1998) is based on a child-centred pedagogy and also assesses resources for indoor and outdoor play.[39] The English rating scale ECERS-E (Sylva et al, 1999) was intended as a supplement to the ECERS-R and was developed specially for the EPPE study to reflect the Desirable Learning Outcomes[40] and more importantly the Curriculum Guidance for the Foundation Stage which at the time was in trail stage. This scale focuses squarely on three curricular areas (Literacy,

[39] ECERS-R sub-scales relate to Space and Furnishings, Personal Care Routines, Language and Reasoning, Activities (pre-school activities), Social Interaction, Programme Structure and Parents and Staffing (adults working together).

[40] Desirable Learning Outcomes have since been replaced by the Early Learning Goals.

Numeracy and Science) and on Diversity of provision for children of different abilities, gender and cultures. The ECERS observations were carried out in each of the 141 centres in the period May 1998 to June 1999. EPPE Technical Papers 6 and 6a give full details of the range in centres' characteristics as measured by these scales. It was found that there was substantial variation between centres of the same type (within-type variation) and also significant variation between types of provision in these measures of quality of pre-school provision. In general, the quality characteristics of playgroups and private day nurseries were found to be lower than those of other forms of provision in the two ECERS instruments. The highest average ECERS scores were found for integrated centres and nursery schools (see EPPE Technical Paper 6). Lower scores were found for other forms of provision.

From the multilevel value added models, the results indicate that quality measures (especially ECERS-E) reveal that pedagogical differences in approach and curriculum focus show a significant relationship with progress in some outcomes. Table 4.4 reports a summary of results. Two overall measures of quality characteristics were tested in the multilevel analysis of centre effects. These were centre average total score on the ECERS-R and on the ECERS-E scale. Only significant effects are reported with *positive* denoting a positive significant effect whilst *negative* shows a negative significant effect. For example, in terms of early number concepts, the analyses shows that there is a statistically positive effect associated with the average total ECERS-E score after controlling for a wide range of child, parent, family, home environment and other pre-school characteristics.

Table 4.4 Impact of quality of provision (as measured by ECERS-R and ECERS-E) on children's cognitive progress (using the complex value added models)

		Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
ECERS_E	Average total	positive **	positive		positive	
	literacy sub-scale	positive	positive			
	maths sub-scale				positive	
	science/envir sub-scale				positive#	
	diversity sub-scale	positive#	positive		positive	
ECERS_R	Average total					
	space & furnish sub-scale					
	personal care routines sub-scale					
	language & reasoning sub-scale					positive#
	pre-school activities sub-scale					
	social interaction sub-scale		positive			

		Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
	organisation & routine sub-scale					
	adults working together sub-scale	**positive#**				

verging on significance ** when change of centre is not in model

To summarise, the results show that:

- There is no statistically significant relationship between children's cognitive progress over the pre-school period and the pre-school centre's average total ECERS-R score (estimates were weakly positive but not significant).

- The pre-school centre's average total ECERS-E score shows a statistically significant positive relationship in terms of children's cognitive progress in pre-reading (when change of centre was not in the model), early number concepts and non-verbal reasoning.

- The average total ECERS-E score though weakly positive is not statistically significant for language and spatial awareness / reasoning (pattern construction)

Further analyses of the ECERS-R and ECERS-E sub-scales[41] show that:

- The ECERS-E literacy sub-scale shows a statistically significant positive relationship with pre-reading and early number concepts progress. In other words children tended to make greater gains, other factors being controlled, if they attended centres that scored more highly on this process measures.

- The ECERS-E diversity sub-scale[42] shows a statistically significant positive relationship with pre-reading (verging on significance), early number concepts and non-verbal reasoning progress.[43]

- For progress in non-verbal reasoning, the ECERS-E mathematics sub-scale is statistically significant (positive) whilst the science and environment sub-scale is verging on statistical significance.

- None of the ECERS-R sub-scales show a statistically significant relationship with cognitive progress in terms language and non-verbal reasoning.

- The ECERS-R sub-scale of 'Adults Working Together' shows a positive impact (verging on statistical significance) for pre-reading.

- The ECERS-R sub-scale of 'Language Reasoning' shows a positive impact (verging on statistical significance) for spatial awareness / reasoning (pattern construction).

[41] See EPPE Technical paper 6 and 6a for further details on the ECERS_R and ECERS_E sub-scales.

[42] The diversity sub-scale includes items on individual learning needs, gender equity and multicultural education.

[43] Askew et al, 1997, Medwell et al, 1998, Black and Wiliam, 1998, Gipps et al, 2000 have all argued that assessment and the provision of feedback are especially important educational strategies. The significant relationship found in the EPPE study was between the ECERS-E sub-scale for diversity and children's progress in pre-reading, early number concepts and non-verbal reasoning supports such arguments.

- The ECERS-R sub-scale of 'Social Interaction'[44] shows a statistically significant positive relationship with early number concepts progress.

The findings confirm the importance of observed measures of quality of pre-school settings as influences on child outcomes. All significant relationships identified are positive (in the direction which would be hypothesised i.e. higher quality promoting better child outcomes), although not all sub-scales show the relationship with the outcome expected. For example, the literacy sub-scale is significantly related to progress in both pre-reading and early number concepts but the mathematics sub-scale is not.

Quality is not a universal concept but depends on national curricula and cultural priorities. The 'outcomes' deemed important in children's development will relate in different ways to different measures of quality. In terms of cognitive progress over the pre-school period, the ECERS-E is found to be a good predictor of children's 'readiness' for school in England (this readiness includes language, 'emergent' numeracy and the component skills of early literacy). More specifically, the average total ECERS-E score and the ECERS-E sub-scales suggest that features of early years pedagogy have a positive impact on young children's cognitive development during the pre-school period. Overall the average total ECERS-R score does not show a significant relationship with cognitive progress although a number of the sub-scales are statistically significant suggesting that certain aspects of environmental quality have a positive impact on cognitive progress. (In EPPE Technical Paper 8b, relationships with social behavioural outcomes are reported. Here the ECERS-R measures show a stronger impact)

Quality Characteristics (in terms of Caregiver Interaction Scale)
Additional measures of pre-school quality are provided by the Caregiver Interaction Scale (CIS) (Arnett, 1989). This scale of adult-child interaction is completed after sustained period of observation with the 26 items forming 4 sub-scales: 'Positive relationships', 'Permissiveness', 'Punitiveness' and 'Detachment'. The 'Positive relationships' identifies favourable aspects of adult—child interaction whereas the other 3 sub-scales represent unfavourable aspects.

Positive relationships is a sub-scale made up of 10 items indicating warmth and enthusiasm in interaction with children by the caregiver.
Punitiveness is a sub-scale made up of 8 items indicating harsh or over-controlling behaviour in interaction with children by the caregiver.
Permissiveness is a sub-scale made up of 4 items indicating avoidance of discipline and control of children by the caregiver.
Detachment is a sub-scale made up of 4 items indicating lack of involvement in interaction with children by the caregiver.

Comparing the ECERS-R/ECERS-E scales and the Caregiver Interaction Scale, there are significant associations between centres in terms of these two separate measures of quality. For example, the overall correlations between the Caregiver Interaction Scale 'Positive relationships' and the ECERS-R sub-scale 'Language reasoning' is 0.64, and with 'Social interaction 0.68 (for more details, see Table D.1 in Appendix D).

Table 4.5 reveals that the behaviour of staff in pre-school centres varies significantly in terms of 'Positive relationships', 'Permissive' and 'Detachment'. Integrated centres, followed by nursery schools and nursery classes score more highly in terms of the Caregiver Interaction Scale measure of 'Positive relationships'. Playgroups score least well on this scale, and show higher mean scores on the 'Detachment' and 'Permissiveness' scale (negative aspects of adult—child interactions) followed by LA day care nursery.

Table 4.5 Mean Caregiver Interaction Scale factors by pre-school type

[44] The ECERS-R Interaction sub-scale includes a strong emphasis upon staff showing respect to children, listening to what they say, and responding sympathetically.

	Nursery classes	Playgroups	Private day nurseries	LA day care	Nursery schools	Integrated centres
Positive	**3.50**	**2.94**	**3.20**	**3.25**	**3.45**	**3.67**
Permissive	**1.30**	**1.62**	**1.49**	**1.59**	**1.44**	**1.31**
Detachment	**1.26**	**1.66**	**1.53**	**1.47**	**1.24**	**1.08**

Note that 'Punitiveness' did not differ significantly by pre-school type so is not included in the table

The multilevel analyses shows that centres' Caregiver Interaction Scale quality ratings show a statistically significant relationship with progress in pre-reading and early number concepts. Children who attend pre-school centres that score highly on the 'Positive relationships' scale make on average more progress in both pre-reading and early number concepts. The other scales (i.e. 'Detachment', 'Permissive' and 'Punitive') by contrast show a significant negative impact on children's progress in these two outcomes.

The analyses of both ECERS and Caregiver Interaction Scale measures indicate that aspects of pre-school centre quality vary significantly both between individual centres and by type of provision. They also demonstrate that process measures of observed quality are statistically significant indicators of young children's cognitive progress during the pre-school period. To summarise, better quality of provision generally has a positive impact.

Staff Qualifications

Information was collected as part of the Centre Manager's Interview about the numbers, qualifications and hours worked by staff of the pre-schools in the EPPE sample (for further details about the characteristics of centres obtained from these interviews see EPPE Technical Paper 5). It might be anticipated that centres with higher proportions of qualified staff hours would benefit children's cognitive development.

In order to explore the impact of staff qualifications a number of measures were constructed from these data. Centres were categorised according the percentage of unqualified, Level 2, Level 3-4, and Level 5 staff hours adapting the "Early Years Education, Childcare and Playwork: A frame of nationally accredited qualifications" (QCA, 1999) classification scheme.[45] The study of staff qualification levels is complicated at the centre level because staff vary in their qualifications and also in the hours they work with children (contact time). Therefore, the percentage of total staff time (hours) at different levels of qualification was calculated for each centre.

Quality characteristics (both overall ECERS-E and ECERS-R and sub-scales) also show a significant link with centre managers' qualification levels (see EPPE Technical Paper 6 Appendix G). Recent analyses of additional observational measures of quality (the Caregiver Interaction Scale sub-scales) also reveal a statistically significant link with the level of centre managers' qualifications. Centres where managers had level 5 qualifications (e.g. a PGCE or teaching qualification) scored significantly higher in Caregivers' interactions with children in terms of 'Positive relationships', and lower in terms of 'Detachment' and 'Permissiveness'. In addition, there was a significant relationship between the percentage of level 5 staff contact time and centres' scores on these three Caregiver Interaction Scale scales. This finding is in accord with that for centre managers' qualification levels. Therefore, we can conclude that centre manager and staff qualifications are positively related with positive aspects of adult—child interaction and negatively associated with negative aspects of adult—child interaction (for further details of centre manager and staff qualifications see EPPE Technical Paper 5).

Staff qualifications generally have no direct impact on centre effectiveness in promoting children's cognitive progress with the exception of pre-reading progress and percentage of staff contact time at level 5. Multilevel results show that there is a significant positive relationship

[45] See EPPE Technical Paper 5 for further details.

between a higher percentage of staff contact time at level 5 and pre-reading progress. Given the positive associations between staff qualification levels and observed measures of centre quality, using the ECERS-R and ECERS-E observational measures, and also in the various scales of the Caregiver Interaction Scale instrument, it seems likely that higher qualification levels lead to higher quality of provision, which in turn benefits child outcomes.

In summary, the relationship between qualifications and effectiveness is complex due to the strong interrelationships with centre type and quality. It is suggested therefore that qualifications probably have an indirect effect on children's cognitive progress through their association with better quality of pre-school provision, but there are indications of stronger associations with aspects of social behavioural development (see EPPE Technical Paper 8b).

Ratios

It is very difficult to study the effects of ratio as a stand-alone variable in existing British practice, without using an experimental study. Munton et al (2002) provide an example of a quasi-experimental study and provide further discussion of ratios and their relationships with staff qualifications and training in the early years. Complexities in measuring class size and ratios in reception classes and in Key Stage 1 have been described by Blatchford et al (2002a and b). The possible effects of ratio in EPPE are inevitably confounded with training, resources and pedagogical practices. Moreover, children from socio-economically disadvantaged and/or minority ethnic backgrounds were concentrated in local authority day care and combined centres whereas children from more advantaged backgrounds were clustered in private day nurseries.

The study has compared three kinds of information on staffing ratios in EPPE pre-school centres:

1) The statutory minimum levels (for when the EPPE children were in pre-school provision)[46]

The minimum staffing level across the 6 types of pre-school provision in the EPPE sample is not uniform. In playgroups, private day nurseries, local authority day care and the combined centres the ratios of 1 adult to 8 children in the age group 3-5 are laid down by the 1989 Children Act. This sets out the statutory levels of staffing which would enable a pre-school setting to comply with the appropriate Children Act inspection framework which historically was undertaken by Social Services. All settings with children under 3 are required to have this inspection of care. In addition, after the introduction of the Desirable Learning Outcomes, the Government introduced an education inspection conducted by the Office for Standards in Education (OFSTED). In the other 'educational' forms of provision, nursery classes and nursery schools, the ratios are 1 adult to 13 for 3 to 5-year-olds, although in nursery schools it can quite often be as low as 1:10 because the head teacher has a major teaching function in addition to administration. These government ratios are determined by the Nursery Education Act(1996). Inspections are conducted by OFSTED but they are similar to school inspections. The integrated centres may differ from these arrangements i.e. if their local authority considers them as nursery schools, they can have the 'education' ratios. However, most integrated centre heads have negotiated lower ratios with their LA because they argue they need lower ratios to carry out the family support aspects of their work. Integrated centres are inspected under both social services and education frameworks.

2) Interview data from the centre managers' interviews

It was possible to calculate staffing levels from the managers' reports of the number of children and staff in their centre. These figures did not necessarily reflect the usual number of children and adults in the centre at any one time and thus provide only a very limited guide to actual ratios usually experienced by children in the centres.

3) Observational data from EPPE research officers' visits

[46] Note that social services inspections are now carried out by OFSTED in line with National Standards for Daycare. The requirement is for settings with children under eight to be inspected as daycare settings.

Independent observations on 'usual' ratios were made over a period of time by research officers during their visits to centres to assess children. In these time-point observations, the number of children in the centre, the number of paid staff, and also the number of voluntary staff were observed. Volunteer staff were only included in the staffing levels if they attended the centre on a regular basis, over a substantial period of time, sufficient to serve as unpaid staff rather than casual visitor. Field officer observations were made on the basis of at least 20 or more separate visits to each centre.

Table 4.6 shows that within each type of provision there was variation between centres in their staff child ratios. This demonstrates the need to explore the impact of both type and ratio in models of children's cognitive progress. It cannot be assumed that all centres of a particular type have similar ratios in practice, thus any comparisons merely based on statutory ratios are likely to be flawed. In general the figures for the ratio of children to adults including volunteers are similar to those without volunteers except in playgroups, where the addition of volunteers reduced the mean observed ratio from 8.43 to 6.96.

Table 4.6 Descriptive Statistics showing the Ratio of Children to Adults (not including volunteers) by Type of Provision

	Statutory ratios	N of centres	Ratio not including volunteers		Ratio including volunteers	
			Mean	sd	Mean	sd
Nursery class	1:13	25	11.51	2.23	11.13	2.44
Playgroup	1:8	34	8.43	3.20	6.96	2.31
Private day nursery	1:8	31	7.16	1.57	7.04	1.56
LA day care	1:8	24	6.69	1.11	6.69	1.11
Nursery school	1:13	20	8.48	3.11	8.00	3.22
Integrated centres	1:13	7	7.63	1.59	7.63	1.59
All	n/a	141	8.37	2.83	7.85	2.65

The relationship between the Early Childhood Environment Rating Scales (ECERS-E and ECERS-R) ratios has also been examined. There is little evidence of associations between centre ratios and quality characteristics as measured by ECERS-R. However, the ECERS-E, which has a more educational focus, showed a significant though weak positive correlation between observed ratio including volunteers and average total score on ECERS-E (r=0.21). This indicates a tendency for quality scores on this measure to be higher in centres with higher ratios. This may reflect the higher ECERS scores to be found in the maintained (Local Education Authority) sector (with ratios of 1:13, see EPPE Technical paper 6 and 6a). The relationships between ratios and the ECERS quality measures are notably weaker than those found between quality and centre manager's childcare/education qualifications levels.

Ratios are also confounded with staff qualifications and quality. Centres where staff had higher qualifications tend to have higher statutory ratios while centres with lower qualified staff have what used to be called 'more favourable' ratios (using the assumption that 'lower' may be 'better' for children). Moreover, some centres with high quality scores on the ECERS observational profiles also have high ratios, especially nursery classes. The important exception to this is the integrated centres, which have high quality scores on ECERS but have low ratios. Some centres with the 'least favourable' ratios offer the highest quality of pedagogy and facilities, especially nursery classes. They also have the most highly qualified staff and better facilities.

The variables 'ratio of children to adults not including and including volunteers' were tested in the complex value added models described in Section 3. (These models controlled for standardised prior attainment and all measures found to be significant predictors of children's cognitive progress). The results show a significant relationship between ratio and cognitive progress for the early numbers concept outcome with children attending centres with higher adult:child ratios making less progress than children from centres with lower adult :child ratios.

It has been shown above that ratios vary in the EPPE study in systematic ways, in particular by type and quality. Therefore ratios, type and ECERS-E (a measure of quality) were all tested in the complex value added models with ratios, once again, shown to be significant predicators of one area of children's cognitive outcomes, early numbers progress.

Amount of Pre-school Provision

The amount of pre-school provision children have experienced can be measured in various ways. In the complex value added models reported in Section 3, the number of months over which a child attended pre-school (created by measuring the number of months from the BAS test date at entry to the EPPE study to the start of primary school[47]) was controlled for. This indicator of 'duration' of pre-school (in terms of number of months) was highly statistically significant in accounting for progress made in each of the five cognitive outcomes.[48] A longer period of pre-school experience was related to greater gains, even when other significant factors are controlled. The baseline attainment measures were standardised on the basis of children's age at assessment, in addition age at follow up assessment in primary school was also controlled. The duration measure excludes time in pre-school prior to age at which children were recruited to the project (i.e. earlier starting age).

The amount of pre-school provision can also be examined by an exploration of the number of sessions per week children were *registered* for at their pre-school settings and also the number of sessions *attended* over the pre-school period from the BAS test date at entry to the EPPE study to leaving the target pre-school. These two measures were tested in the complex value added models reported in Section 3 which take into account the variable number of months of pre-school. As to be expected, the three measures of amount of pre-school provision are inter-related to some extent. Therefore, number of sessions registered at target pre-school and attendance at the target pre-school over pre-school period (from BAS test) were also tested in the complex value added models with the variable measuring number of months in pre-school excluded.

The number of sessions per week children were registered for at their pre-school settings is generally considered a relatively crude indicator of amount of provision. Table 4.7 details the number of sessions per week for which children were registered at their target pre-school. As can be seen, no children in the EPPE pre-school experience sample were registered to attend only 1 session. The majority were registered to attend 5 sessions (44%) whilst 23% were registered for 10 sessions a week. The mean number of sessions per week for which children are registered varied by type of provision with the highest providers generally being local authority day nurseries and the lowest playgroups (as shown in Table 4.8). It should be noted that some children will have changed the number of sessions per week they attended during the study and thus the number of sessions registered per week measure recorded at entry may not have applied throughout the pre-school period.

[47] Note that the number of months of pre-school attended before the child entered the EPPE study is not included in this duration measure. A separate 'duration' measure of amount of time in pre-school prior to entering the study was tested in the simple value added models and was not significant in terms of progress in any of the 5 outcomes (note that this 'duration' measure is confounded with prior attainment).

[48] For example, referring to Table C.1 in Appendix C, on average a child will make 0.3 points of progress on pre-reading scores for each month of pre-school experience. In other words eighteen months attendance is equivalent to raising achievement by about 5.4 points (approximately half a standard deviation) of the pre-reading outcome at start of primary school.

Table 4.7 Number of Sessions per week for which Children were Registered at Entry to the Study

Numbers of sessions per week	2	3	4	5	6	7	8	9	10
N	209	283	254	1267	97	11	75	15	642
%	7.3%	9.9%	8.9%	44.4%	3.4%	0.4%	2.6%	0.5%	22.5%

Table 4.8 Mean Number of Sessions per week for which Children are Registered According to Pre-school Type

	n of children	mean	sd	n of centres
Nursery class	588	5.84	1.87	25
Playgroup	609	3.69	1.47	34
Private Day Nursery	513	5.29	2.67	31
LA Day Care	432	8.00	2.64	24
Nursery school	519	6.27	2.13	20
Integrated centre	192	6.89	2.35	7
All	2853	5.76	2.56	141

In the multilevel analyses of progress children registered for 5 sessions were compared to those registered for 2-4 sessions and also children registered for 6-10 sessions. The results showed no significant impact on progress for number of sessions per week a child was registered to attend at his or her centre. The models included control for prior attainment, change of centre, number of months of pre-school and all other measures which were found to be significant predictors in the complex value added analyses of progress described in Section 3 of this report. [49]

Attendance records are generally considered a better indication of quantity of pre-school provision than number of sessions registered per week as holiday closures and absences are taken into account in the calculation. However, a limitation of the attendance variable used (which measures the total number of sessions attended over the pre-school period from the BAS test date at entry to the EPPE study to leaving the target pre-school based on centre registers) is that attendance is only measured for the target pre-school centre. As reported in Table 1.2 in Section 1, just under a quarter of the sample (23.0%) moved from the target pre-school centres from which they were recruited at entry to the study during the pre-school period. Thus for these children who changed pre-school, the attendance measure only accounts for a proportion of their pre-school experience. Table 4.9 shows that children varied in their attendance by type of pre-school provision with the highest providers generally being local authority day nurseries and the

[49] It should be noted that the contextual analysis of attainment at entry to pre-school (reported earlier in EPPE Technical Paper 2) showed that number of sessions registered per week in target pre-school centre was significantly positively related to cognitive attainment at age three plus years.

lowest playgroups (from which over half the children change target pre-school during the pre-school period).

Those children who attended up to 130 sessions at the target pre-school (from BAS test date until exit) were compared in the multilevel analyses to children who attended for 131-200 sessions, 201-400 sessions and over 400 sessions[50]. Using the complex value added models reported in Section 3 (but not controlling for number of months in pre-school), children who attended for less than 130 sessions made significantly less progress in the language and picture similarities outcomes than children who attended over 200 sessions. Furthermore, this variable measuring attendance at target pre-school centre (from BAS test date) also showed a significant positive relationship with cognitive progress in pre-reading and early number concepts although the difference was only statistically significant for the group that had 400 or more sessions in comparison with those that attended the target pre-school for 130 or fewer sessions in total.

As noted above, the attendance measure is confounded by type and stability with playgroups showing more change than other types. Total number of sessions attended tends to be lower for those children who change centre unstable arrangements (usually playgroups) leading to artificially low attendance figures because such children often moved to other centres but no details of attendance at non-target pre-school centres were available. Hence it seems likely that the significant positive effect reported for attendance on 3 of the 5 cognitive variables may be viewed as a conservative estimate of the effect of quantity of sessions attended.

Table 4.9 Attendance (mean total number of sessions at target centre during study period) by Pre-school Type

	n of children	mean	sd	n of centres
Nursery class	**485**	**176**	**90.0**	**25**
playgroup	**570**	**114**	**77.6**	**34**
Private day nursery	**490**	**246**	**164.9**	**31**
LA day care	**401**	**320**	**193.3**	**24**
Nursery school	**482**	**160**	**72.7**	**20**
Integrated centre	**134**	**264**	**157.6**	**7**
All	**2562**	**200**	**145.3**	**141**

Child Age at Start of Pre-school Centre

Results in Technical Paper 2 and 7 show that an earlier age at entry to pre-school is related to higher cognitive attainment at age 3 years plus, particularly in verbal attainment. Children who enter at an earlier age are mostly drawn from private day nurseries, local authority nurseries and integrated centres. Table 4.10 shows the mean age and distribution of children in terms of age in months at entry to target centres.

Table 4.10 Age in months at start of target pre-school to according to pre-school type

	n of children	mean	sd	min	max	n of centres
Nursery class	**588**	**43.9**	**4.0**	**28.1**	**52.0**	**25**
Playgroup	**609**	**34.0**	**3.8**	**21.4**	**50.5**	**34**
Private day nursery	**516**	**25.5**	**12.1**	**1.2**	**51.3**	**31**
LA day care	**433**	**26.2**	**11.9**	**1.0**	**50.1**	**24**

[50] The number of children in these groups are as follows: 130 or fewer sessions n=957 (33.5%), 131-200 sessions n=715 (25.0%), 201-400 sessions n=613 (21.5%) and over 400 sessions n=277 (9.7%). Attendance information was not available from centre records for 295 children (10.3%).

Nursery school	**519**	**43.5**	**4.1**	**35.2**	**52.3**	**20**
Integrated centre	**192**	**34.0**	**10.0**	**3.3**	**49.8**	**7**
All	**2857**	**35.0**	**11.0**	**1.0**	**52.3**	**141**

Analyses have been conducted to explore the impact of age starting in pre-school in more detail. The categories tested are: starting the target pre-school under 2 years old, between 2 to 2½ years, between 2½ to 3 years and starting age 3 or above.[51] When examining attainment at entry to school in the contextualised models of attainment (as detailed in Section 2 but without duration of pre-school included), the results indicate that children who start at the target centre at a younger age continue to have higher cognitive scores when they enter primary school for all outcomes except spatial awareness. The cognitive benefits of an early start are strongest for children starting between the ages of 2 and 2½ years compared with children who start at the target centre age over 3 years. Children who start below the age of 2½ attain higher BAS cognitive scores at entry to the study and have higher pre-reading scores at entry to school than those children who start pre-school when they are over 3 years. It should be noted that the results show that there are no greater cognitive benefits in starting pre-school under two years of age, than between 2 and 2½.-

In terms of progress over the pre-school period measured by the value added models, the results show that a younger age at entry does not result in increased progress when prior attainment and duration of pre-school (from entry assessment to start of primary school) are controlled.

Season of birth

Previous research (Sharp, 1995) has shown that season of birth is significant in terms of baseline assessment. Thus, a variable was constructed to measure season of birth: autumn born (i.e. September—December), spring born (i.e. January—April) and summer born (i.e. May—August). This 'season of birth' measure was tested in the complex value added models reported in section 3. It is important to note that these models control for all measures found to be significant predictors of cognitive progress such as age of child at outcome assessment and duration of pre-school (measures which are also likely to be correlated with season of birth). The multilevel results show that season of birth is significant for early number concepts with children born in the summer making significantly less progress than children born in the autumn.

Parental involvement

As part of the exploration of the contribution of parents to young children's learning, the extent to which parents became involved with their child's pre-school centre was investigated using various sources of data. From the centre managers' interview, variables were constructed reflecting parental visits to the centre, production of written materials for parents, parental education activities, parental involvement in meetings, staff opinions of the value of parental involvement and staff opinions on how well their centre caters for parents. Whilst information from these interviews cannot provide a complete and comprehensive measure of all aspects of 'parental involvement', it does give an indication of the perceptions of the centre managers in the EPPE study about the contact they have with their parents. Those variables reflecting the production of written materials for parents and parental education activities were significantly related to children progress over the pre-school period. Additionally, an item reflecting provision for parents forms part of the ECERS-R sub-scale of 'Parent and Staff'. This item was related to aspects of child progress (non-verbal reasoning).

In order to further explore this issue a 'parental involvement index' was constructed using the centre manager's interviews data (written materials for parents and parental education activities), the ECERS data (provision for parents) and parental interview data (various types of involvement such as meetings, fund raising and helping maintain the centre). These three sources of data

[51] The number of children in these groups are as follows: starting the target pre-school under 2 years old n= 360 (12.6%), between 2 to 2½ years n= 276 (9.7%), between 2½ to 3 years old n= 703 (24.6%) and starting age 3 years old or above = 1518 (53.1%).

were equally weighted in producing the overall 'parental involvement index' and were tested in the multilevel models to explore any effects upon child progress after controlling for all measures found to be significant predictors in the complex value added models of progress described in Section 3 of this report.[52] For cognitive progress, the results indicate that the overall 'parental involvement index' shows a positive significant relationship with non-verbal reasoning and a positive relationship, approaching significance, for numeracy.

[52] It is important to note that activities associated with the home learning environment (i.e. activities that parents undertake at home with pre-school children such as reading to children, library visits, painting/ drawing, teaching letters and numbers) are significant predictors in the complex value added models. These activities demonstrate a positive parental orientation towards developing their child's learning and, encouragingly, the results suggest that what parents do has strong positive effects.

Section 5: The Impact of Pre-School Provision: Comparison of Home Children to Children who attended a Pre-school Centre

In order to make comparisons of the attainments of children who have had no or only minimal pre-school centre experience with those children who had attended a target pre-school, an additional sample of home children was recruited to the EPPE study. Home children were classified as those who had experienced less than 10 weeks at 2 sessions per week (i.e. less than 50 hours) of pre-school before entering school. It should be noted that home children may have had experience of toddler groups, child minders, nannies or other carers[53] but had no or only minimal pre-school institutional experience. This section presents the results of contextualised multilevel analyses establishing whether home children attain less highly at primary school entry than children who have had some form of pre-school centre experience, after controlling for the impact of differences in child, parent and home learning environment characteristics.

It had been hoped to recruit 500 home children during the first weeks of reception from amongst children starting at primary schools that the main EPPE pre-school sample entered.[54] In practice the recruitment of home children proved very difficult, reflecting the increased access to, and take up of, pre-school provision (perhaps reflecting Government policy to expand pre-school provision from 1997 onwards). Many children recorded as having no pre-school centre experience on their school records were subsequently found at parental interview to have attended a centre and did not meet the criteria to be part of the 'home' sample. It proved possible to identify just under 200 children meeting the home child requirement from 10% of the primary schools which the EPPE children from target pre-school centres entered. A further 100+ home children were recruited from a small number of other primary schools nearby.[55] Amongst home children recruited, the main reasons reported in the parental interview for the child not having had any centre-based pre-school experience were that there was no appropriate provision close to hand, no pre-school places available, the parent wanted to spend more time with the child or the child was 'clingy'/unsettled.[56].

Chart E.1 in Appendix E shows the distribution of EPPE children (both with and without pre-school provision) in primary schools. The mean number of EPPE children per primary school is 4 with a standard deviation of 5. In terms of numbers of children from the EPPE sample (both children with pre-school experience and home children), just under half of the primary schools only have one child, a sixth of the schools have two children and one school notably has 60 children (all home children).

EPPE Technical Paper 3 reported that some of the local authorities in the study, during the reconfiguration of their early years services, had found areas where there was a lack of early years provision or lack of knowledge about the provision that existed. Therefore some groups of children, and in two of the five regions especially minority ethnic groups, were over-represented in the 'home' category. The sample of 'home' children reflects this anomaly and this has led to clusters of 'home' children being recruited in some areas from particular schools, with an over-representation of minority ethnic groups. The EPPE home sample is probably therefore typical of the way in which 'pockets' of home children are unevenly distributed in some localities.

[53] Childminders, nannies and informal carers may provide a stimulating learning environment but the study had no measures of this. Information about home learning environment was collected from parental interviews for all children in the sample.
[54] The 2857 EPPE children from 141 target centres entered 770 different primary schools.
[55] In total, 314 home children were recruited to the EPPE study from 96 different primary schools.
[56] Other reasons were that the available provision did not fit parental work patterns, it was unaffordable or parents were unhappy with the level of hygiene. Additionally, a small number of parents wanted to teach their child at home, were housebound or felt that their child was too young to attend a centre.

Characteristics of the Home Children Compared with Children who Attended a Pre-school Centre

Table 5.1 provides descriptive statistics for the home children compared with children in the EPPE sample who attended a pre-school centre. As can be seen, home children differ considerably in some of their background characteristics from other EPPE children with pre-school experience. For example, home children are more likely to be from ethnic minority groups, in particular Pakistani, with a higher proportion of children for whom English is an additional language recorded in the home child category. Furthermore, a notably higher percentage of home children are from larger families and have mothers with no formal qualifications. A third of home children (compared with just over a fifth of children who attended pre-school) receive free school meals. However, it should be noted that the FSM data for reception aged children provides only a partial measure of socio-economic disadvantage since many young children have home dinners at this age and therefore do not take up their entitlement to this benefit. This may be more likely for children from certain ethnic minority groups (e.g. Bangladeshi, Pakistani).

Table 5.1 The Characteristics of Home Children Compared with Children who attended a Pre-school Centre

		Children from target pre-schools centres		Home children	
		n	%	n	%
Gender:	**male**	1489	52.1	146	46.5
	female	1368	47.9	168	53.5
Ethnicity*	**White UK**	2127	74.5	168	53.5
	White European	118	4.1	4	1.3
	Black Caribbean	116	4.1	0	0
	Black African	64	2.2	2	0.6
	Black other	22	0.8	0	0
	Indian	55	1.9	12	3.8
	Pakistani	75	2.6	102	32.5
	Bangladeshi	25	0.9	15	4.8
	Chinese	5	0.2	0	0
	Other	62	2.2	4	1.2
	Mixed heritage	185	6.5	7	2.2
English as a Second Language		249	8.7	118	38.2
Receiving free school meals		598	22.5	103	33.9
3 or more siblings		374	13.4	109	39.5
Mother has no formal qualification		501	18.1	146	57.0
Area	**East Anglia**	559	19.6	91	29.0
	Shire Counties	594	20.8	10	3.2
	Inner London	656	23.0	11	3.5
	North-east	503	17.6	75	23.9
	Midlands	545	19.1	127	40.4

*not known excluded

The mean and standard deviation for the five cognitive attainment in the primary school entry assessments are shown in Table 5.2. It can be seen that on every measure the home children's mean scores are markedly lower than those of children with pre-school experience. As a group, therefore, children without pre-school experience are well behind other children in all areas of cognitive development. However, without further analysis, it cannot be concluded that these

lower scores are a direct result of lack of pre-school experience due to the very different characteristics of the home child sample which are also likely to influence their attainment. Nonetheless the data would suggest that there is an association that is worth further exploration using more complex statistical models to separate the impact of no pre-school experience from other factors. (For further discussion of the impact of multiple disadvantage and risk of SEN for the home group compared with the EPPE children experiencing pre-school provision see Appendix F and EYTSEN Technical Paper 1.)

Table 5.2 Descriptive Statistics of School Entry Assessments for Home Compared With Children Pre-school Experience

	Children with Pre-school experience			Home children		
	n	Mean	sd	n	mean	sd
Pre-reading	2705	21.57	12.67	239	12.33	10.86
Early number concept	2711	18.50	5.66	240	13.19	6.20
Language	2725	42.13	7.68	239	34.94	8.79
Non-verbal reasoning	2733	22.38	4.54	313	19.30	5.12
Spatial awareness/reasoning	2585	11.60	7.27	271	6.92	5.40

A Contextualised Analysis of the Home Children's Cognitive Attainments at Primary School Entry Compared to Children who Attended a Pre-school Centre

In order to explore in detail home children's cognitive attainment at entry to primary school, a strategy for analysis was employed where children with no pre-school provision were compared firstly to all children with pre-school provision as a group and then to children from the six different types of pre-school provision. The impact of pre-school was also examined by comparing the cognitive attainments of children with varying durations of pre-school provision.

A categorical variable indicating pre-school centre provision versus no pre-school centre attended was added to the contextualised models described in Section 2.[57] Table 5.3 shows the results of the multilevel analyses indicating that, after controlling for the impact of child, parent and home learning environments influences, home children remain at a significant cognitive disadvantage compared with children who have had pre-school experience. The impact of no pre-school provision is statistically significant for attainment in three cognitive outcomes, namely pre-reading, early number concepts and language attainment at entry to primary school. In terms of effect sizes the strongest impact of any pre-school experience versus none is on language development (0.44) and early number concepts, (0.44), with a moderate effect for pre-reading (0.28).

Table 5.3 shows that after controlling for the child, parent and home learning environments factors noted in Section 2, a child with pre-school centre experience attains on average a pre-reading score of 2.7 points higher than a child without such experiences. By way of comparison, having a mother with academic qualifications at age 18 adds 2.4 score points on a child's pre-reading attainment compared to children whose mothers have no qualifications at all. Similarly, data for early number reveal an increase of 2.0 points for pre-school vs home as compared with a 1.5 points increase for having a mother with 'A' levels. Therefore for the early literacy and numeracy outcomes, the effect of attendance at pre-school is similar in size to the effect of a mother's academic qualifications (at age 18). There were no significant differences for attainment in the two non-verbal measures.

[57] The contextualised models in Section 2 controlled for an intake compositional variable, namely the percent of children in a pre-school centre whose mothers have degrees, higher degrees or other professional qualifications. As home children did not attend a pre-school centre, it is not possible to include this variable when home children are in the models.

Table 5.3 Multilevel results showing the effect of no pre-school provision on attainment at primary school entry

	Pre-reading	Early number concepts	Language
No pre-school centre provision (compared to any pre-school centre provision)	**-2.685* (0.943)**	**-1.999* (0.425)**	**-2.541* (0.526)**

* statistically significant at 0.05 level

It is also of interest to examine the impact on children's cognitive attainment of no pre-school provision compared to the different types of pre-school provision examined within the EPPE research. Thus, type of pre-school was added to the model with no pre-school provision as the comparison group. The results suggest that all types of pre-school provision compared to none show a significant positive relationship with higher cognitive attainment in early number concepts and language.[58] Table 5.4 reports the types of pre-school provision showing a positive, statistically significant (at the 0.05 level) impact on attainment. Results of spatial awareness/reasoning are omitted as no significant differences between types of provision were found in the multilevel analysis.

Table 5.4 Multilevel results showing the effect of no pre-school provision compared to different types of pre-school provision on attainment at primary school entry

	Pre-reading	Early number concepts	Language	Non-verbal reasoning
Nursery classes	**positive**	**positive**	**positive**	
Playgroups		**positive**	**positive**	
Private day nurseries	**positive**	**positive**	**positive**	**positive**
LA day care	**positive**	**positive**	**positive**	**positive**
Nursery schools		**positive**	**positive**	
Integrated centres		**positive**	**positive**	**positive**

statistically significant at 0.05 level

Additionally, the impact of pre-school provision can be explored by examining the 'duration' of pre-school (measured from date of entry to the target pre-school centre) using the following categories:

- no pre-school centre experience i.e. home children (n=314)
- up to 1 years pre-school experience (n=556)
- 1-2 years pre-school experience (n=1095)
- 2-3 years pre-school experience (n=774)
- more than 3 years pre-school experience (n=290).

Table 5.5 shows the results of the contextualised analysis of all EPPE children (home and those with pre-school centre experience) taking into account the above variables measuring the varying degrees of 'duration' of pre-school in addition to child, parent and home environment factors discussed in Section 2. In general, the results show that children who have spent more time in pre-school have significantly higher cognitive attainments except for the spatial awareness/reasoning outcome (where the results are generally positive but not significant).

[58] It should be noted that these models could not include compositional measures which are particularly relevant to the impact of private day nurseries (see Section 4).

Table 5.5 Multilevel results showing the impact of the net effect of varying degrees of 'duration' of pre-school on attainment at primary school entry after controlling for child, parent and home learning environment characteristics

Compared to no pre-school experience i.e. home children	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
< 1 yr pre-school	1.189 (1 .027)	1.517* (0.460)	2.689* (0.611)	0.385 (0 .396)	-0.014 (0.625)
1-2 yrs pre-school	2.641* (0.979)	2.012* (0.441)	2.234* (0.544)	0.541 (0.351)	0.265 (0.593)
2-3 yrs pre-school	3.723* (1.013)	2.502* (0.458)	2.522* (0.568)	0.714 (0.368)	0.213 (0.614)
> 3 yrs pre-school	4.633* (1.135)	2.467* (0.516)	3.630* (0.631)	1.022* (0.412)	0.622 (0.686)

* statistically significant at 0.05 level

In terms of effect sizes these multilevel analyses of attainment illustrate that, in general, the longer a child was in a target pre-school centre, the stronger the positive impact on attainment (see Chart 4.1). Effect sizes for those with 2-3 years or more than 3 years in a target pre-school tend to be strongest (ranging from 0.44-0.63 for language, 0.54-0.55 for early number and 0.38 to over 0.48 for pre-reading).

In summary, although as a group home children differ form the EPPE pre-school sample in terms of their background characteristics (being generally more disadvantaged), these differences do not fully account for their lower attainments. After controlling for the impact of child, parent and home learning environments influences, the attainment gap between home children and those who have had pre-school experience remains. This gap is not merely attributable to differences in the background characteristics of these two groups. In particular for the outcomes pre-reading, early number and language skills, pre-school experience is shown to confer a significant cognitive advantage with attendance at *any* pre-school provision showing a positive impact in terms of child cognitive development. In addition, duration in pre-school is significant showing that, in general, children who have spent *more* time in pre-school have higher attainments. The effect sizes for the impact of pre-school (compared with none) are moderate to high, particularly when duration is examined. Effect sizes indicate that children with 2-3 years or 3 years plus time at pre-school tend to show the highest attainments. As children continue through the educational system, further analyses will be conducted to explore the progress of these children during Key Stage 1 to establish whether the 'gap' in achievement between home children and those who experienced pre-school reduces or remains constant as they progress through school.

Chart 4.1 Effect sizes for amount of pre-school experience compared with none (the home group) for attainment at primary school entry in pre-reading, early number concepts and language assessments

effect size
0.00
0.20
0.40
0.60
PRE-READING > 3 yrs duration cf no pre-school attende
PRE-READING 2-3 yrs duration cf no pre-school attende
PRE-READING 1-2 yrs duration cf no pre-school attende
PRE-READING up to 1 yr duration cf no pre-school attende
NUMBER 2-3 yrs duration cf no pre-school attende
NUMBER >3 yrs duration cf no pre-school attende
NUMBER 1-2 yrs duration cf no pre-school attende
NUMBER up to 1 yr duration cf no pre-school attende
LANGUAGE > 3 yrs duration cf no pre-school attende
LANGUAGE up to 1 yr duration cf no pre-school attende
LANGUAGE 2-3 yrs duration cf no pre-school attende
LANGUAGE 1-2 yrs duration cf no pre-school attende

Section 6: Summary and Conclusions

In England some form of pre-school experience in an institutional setting has become increasingly the norm for young children prior to the start of school. During the 1990s different governments adopted a range of policies which sought to expand the availability of pre-school places. Economic growth and the trend for women with young children to continue in employment have led to increased demand for pre-school places in many developed countries (Scarr, 1998). The care and education roles of pre-school provision have been debated and the early years have been increasingly recognised as important in preparing young children for a better start at primary school. From 1997 Early Years policy sought to encourage local integration, bringing together education and care, and to increase the supply of quality free places for children aged 4 and an agreed percentage of those aged 3 years. Early Years Development and Care Partnerships were created to bring together the range of providers of education and care services for young children and national guidelines were published. National initiatives such as Sure Start and Early Excellence centres were also promoted (see Jackson, 2000 for a discussion of New Labour's early years policy changes).

The policy context experienced by pre-school centres in the EPPE study has been described in EPPE Technical Paper 3. This investigated the perceptions and experiences of pre-school centre managers and local authority co-ordinators. The EPPE study was designed to investigate the impact of pre-schools on young children's developmental outcomes. This report describes the results of analyses of young children's attainments at the start of primary school, and also their cognitive progress during their time in pre-school, from age 3 years plus to rising 5 for most children. Progress was measured using prior attainment at entry to target centres in the EPPE study as a baseline and analysing patterns of change in attainment over the pre-school period until the start of primary school in terms of different cognitive outcomes. The five cognitive outcomes assessed at entry to primary school are, language, two non-verbal measures, early number concepts and pre-reading skills. A range of statistical methods has been used to analyse data for around 2800 children, representing around 95 per cent of the total child sample at entry to the study. Multilevel modelling has been used to identify and explore pre-school centre effects. In addition, the attainments of an additional sample of home children recruited at the start of primary school bring the total sample to over 3100 for some analyses that seek to compare the impact of not attending pre-school with the influence of attending a pre-school centre.

The analyses have explored the extent of variation in young children's attainments in school entry assessments for different groups of children. The contextualised analyses reported in Section 2 show that, while still important predictors of attainment, child, parent and home environment characteristics of children account for a lower proportion of the variance in attainment at school entry for pre-reading and early number concepts measures than was the case for language attainment at entry to the pre-school study. It is argued that this may reflect the positive impact of pre-school experience and its ability to help reduce the inequality in cognitive development already evident at age 3 plus years at entry to pre-school. Background remains powerfully associated with variations in young children's language attainment when children start primary school (age rising 5 years). This may point to the need for more intensive work on language enrichment for young children who show poor language development at the start of pre-school.

Additional analyses of children 'at risk' of SEN in terms of low cognitive attainment at entry to the pre-school study were conducted. The 'at risk' group represented around 1 in 3 of children at age 3 years plus (at risk children are defined as those with scores 1 sd below the average in terms of national norms) but this proportion had fallen to 1 in 5 of the pre-school sample by the time they started primary school (see EYTSEN Technical Paper 1 and Appendix F for further details). This provides additional evidence of the cognitive benefits of attending a pre-school centre for the most vulnerable groups (the 'at risk' group were much more likely than other children to experience multiple disadvantage).

The analyses reported here show that the choice of school entry measures can have equity implications. Differences related to children's gender, language (EAL) and ethnic background are more likely to be identified in measures of language and pre-reading skills than in non-verbal attainments or early number concepts. It is important that accurate measures of children's attainments at school entry are obtained covering a range of areas of attainments so that different areas of strength/weakness can be assessed and children receive additional support or appropriate challenge as appropriate. In particular, a focus on mainly language based measures for school reception assessment may disadvantage some children of particular ethnic/language backgrounds. Such differences should not be ignored, however, because of their relationship with later attainment. Longitudinal monitoring of children's attainments from pre-school through primary school is important to allow equity issues to be explored and to establish whether there are changes in the achievement gap for vulnerable groups.

The contextualised analyses of attainment at primary school entry confirm the importance of the home learning environment for young children's cognitive attainment especially in language, pre-reading and early number concepts (in line with earlier findings on its importance for cognitive attainment at age 3 years plus at entry to the study). For further discussion of research evidence concerning parents and parenting in the early years see Sylva and MacPherson (2002).

When children's cognitive progress is measured over the pre-school period the impact of child, parent and home environment characteristics is found to be much smaller than when variations in attainment at any one time point, either at the start of the study or later at primary school entry, are explored. It must be remembered that such characteristics showed a strong relationship with prior cognitive attainment (measured at entry to the target pre-school at age 3 years plus), and prior attainment is used as the baseline for measuring progress. Nonetheless, a number of characteristics also exhibit a statistically significant influence on progress over the pre-school period. Such characteristics show a stronger association with language and pre-reading than other outcomes. These results point to the need to make appropriate statistical control for differences in the characteristics of young children who attend different pre-school settings, both at the level of individual centres and by type of provision. This is essential to ensure that comparisons of the impact of different centres or types of provision are made which reflect the importance of intake differences.

Variations in centre effectiveness

The multilevel analyses of children's progress show that significant centre-level variance in children's cognitive progress remains, even when account is taken of prior attainment and other intake differences, such as child, parent and home environment characteristics. Pre-school effects are larger for pre-reading followed by early number concepts, possibly reflecting different emphases in pre-school curriculum provision and the priority accorded to different types of activities between individual centres in the sample. Despite the relatively small number of children in the EPPE study in some centres, a number of statistically significant outlier centres were identified. These centres were ones where children showed significantly better progress (in the case of positive outliers), or, by contrast, significantly poorer progress than predicted (negative outliers), given their prior attainments and background. In all, only 33 (23.4%) of the 141 centres that were identified as performing broadly as expected (compared with other pre-school settings in the sample) across all areas of cognitive progress assessed, when intake differences are controlled. By contrast just over one in 5 centres (22.0%) were found to be statistical outliers (performing significantly above or significantly below expectation for one or more cognitive area), This is likely to be a fairly conservative estimate of the extent of real differences in effectiveness between individual centres because, with small numbers at the centre level, an effect has to be much larger to reach statistical significance.

The typical pattern is for centres to vary somewhat in their effects on different cognitive outcomes. No centres performed significantly above or significantly below expectation for all cognitive outcomes. An important finding is that pre-school centre effects are only very moderately correlated in language, early number concepts, pre-reading and the two non-verbal

measures. This suggests that pre-school settings show much internal variation in effectiveness and is in line with findings from studies of schools which suggest that effectiveness is usually outcome specific (Sammons, 1996). Nonetheless, the most usual profiles across the five outcomes studied show that a number of centres could be distinguished with broadly positive effects whereas others showed generally poorer effects on cognitive progress.

Child mobility was found to be significant. Over a fifth of children (23%) had left their target centre before starting primary school and moved to other provision. This varied significantly for different types of provision being very uncommon for those in nursery classes or nursery schools. By contrast the majority of playgroup children (52%) had moved centre, often to a different form of provision. A change of centre was significantly associated with poorer progress in pre-reading. The much higher incidence of movement from the target playgroups has implications for the analysis of the effects of this type of provision, and the effects of individual centres. The high degree of mobility means that it is very difficult to measure the impact of playgroups on children's progress (either at the level of individual centres or as a type of provision) accurately. Children who changed centre were followed up in their new centres and a separate paper will explore the developmental progress of mobile children in more detail.

The impact of pre-school – quantity and quality

A number of the analyses point to the importance of pre-school for young children's cognitive development. Taking account of other child, parent and home factors, children who started pre-school at a younger age i.e. below 3 years of age (mainly associated with three types of provision, local authority day nursery, private day nursery and integrated centre) had higher cognitive attainments at the start of the project (assessed at 3 years) than those who started at an older age. However, the minority who started below 2 years of age did not show more positive outcomes than those who started at age 24-36 months. This cognitive advantage for an early start was still evident when children started primary school.

In addition, 'duration' of pre-school (measured by the number of months over which a child attended pre-school between date of entry assessment and date of starting primary school) showed a significant positive link with young children's cognitive progress during pre-school for all five cognitive measures. A longer period of duration (in months) of pre-school was associated with greater cognitive gains.

Data about number of sessions per week for which a child was registered at the target pre-school was not found to relate to amount of cognitive gain during pre-school, when the impact of other factors was controlled. No evidence was found that full time provision (10 sessions) resulted in better outcomes than part time provision (i.e. 5 sessions).

A measure of quantity of attendance (total number of sessions a child was recorded as having attended at their target pre-school centre during the study from date of entry assessment until exit from the target pre-school based on centre registers) was related to greater progress for language and picture similarities (also for pre-reading and early number concepts but to a lesser extent). Duration of pre-school (measured in months) however, showed a stronger link than quantity of attendance, when both measures were tested in the statistical models.

Quality of pre-school provision (measured by the total ECERS-E scale, though not the total ECERS-R scale) was also positively related to children's cognitive progress in several areas. The ECERS-E instrument was developed specially for the EPPE study to reflect the Desirable Learning Outcomes and the Curriculum Guidance for the Foundation Stage that at the time was in its trail stage. It was positively related to effectiveness in promoting pre-reading, early number concepts and non-verbal reasoning. The literacy sub-scale was also positively related to progress in pre-reading and early number concepts, while the diversity sub-scale (which includes items on differentiation, observation, individual record keeping and ability grouping) was also significantly related to progress in pre-reading, early number concepts and non-verbal reasoning.

The results of analyses of the ECERS-R sub-scales also suggest that some aspects of quality measured by this instrument are associated with better cognitive outcomes at primary school entry (though this instrument shows a stronger link with social behavioural development as reported in EPPE Technical Paper 8b). In addition, another observational instrument was analysed which provides measures of adult—child interactions (the Caregiver Interaction Scale). The sub-scale Positive relationships was related to better pre-reading progress, whereas the three scales which assess negative aspects of interaction (Detachment, Permissive and Punitive) showed a negative impact for pre-reading and early number concepts progress.

There were no significant associations (interactions) in the relationship with progress between the ECERS quality measures and disadvantaged groups (as measured by low SES or mother having no educational qualifications). This indicates that quality of provision is positively related to progress for all children (socio-economically and educationally advantaged and disadvantaged alike). A positive interaction for gender and quality was found, however, indicating that boys show a greater benefit in terms of cognitive progress for early number concepts. This suggests that boys are most likely to make progress if they attend high quality provision. Given that, as a group, girls made greater cognitive gains and had higher attainments at entry to pre-school, the positive impact of pre-school quality for boys' progress is of special interest.

Significant type of provision effects were identified at school entry controlling for other factors. It should be noted that type of provision was not significantly related to variations in young children's attainment at entry to pre-school, when account was taken of differences in intake in terms of child, parent and home environment characteristics (EPPE Technical Paper 2).

In analysing type of provision effects, the analyses controlled for differences duration of pre-school, as well as mobility (change of centre), since these were also identified as statistically significant. In addition to individual child, parent and home environment measures, the analyses took account of compositional influences. It was found that children in centres that served a higher proportion of children whose mothers were highly qualified in educational terms (had a degree/higher degree or other professional qualification) tended to make more progress in some outcomes, particularly pre-reading. Private day nurseries (reflecting the paid for nature of provision) tended to serve more children from educationally advantaged backgrounds. If compositional effects are not included in the model, this form of provision showed particularly significant positive effects for pre-reading progress.

Overall, the results did not indicate that any one type of provision was superior to all other types for progress for all five of the cognitive outcomes. Nonetheless, integrated provision (i.e. combined centres) showed a significant positive impact for several measures, whereas children who attended local authority day care centres tended to make relatively poorer progress in several areas compared with all other types. Nursery schools also showed positive effects for two areas and were not significantly different from integrated provision in terms of effectiveness. The analyses also indicated that there were interactions for low SES children with type of provision, children in the low SES group showing better outcomes if they attended integrated provision or nursery schools.

The category private day nursery showed significantly better results than local authority day care for pre-reading and language progress. A number of the positive outlier centres for pre-reading were found to be private day nurseries. This may reflect curricular differences in emphasis and priorities.

Overall, there was significant variation in effectiveness on cognitive progress within each type of provision; thus it can be concluded that differences between individual centres are likely to be more important than differences between type. It should be noted that the high mobility of children in playgroups makes the estimation of separate type of provision effects for playgroups difficult.

The presence of compositional effects would suggest avoiding policies that result in the clustering of disadvantaged children within specific centres, although this may be difficult in some areas given many parents' preferences/needs for a local centre in close proximity to home.

Earlier analyses have shown that there is significant variation both between individual centres and by type of provision in the observed quality of provision (see EPPE Technical Paper 6). In addition the ECERS and Caregiver Interaction Scale measures of quality are fairly closely related. When account is taken of variation in quality of centre environments, the impact of type of provision is reduced. Given this, we can conclude that variations in centre quality are, at least in part, responsible for differences in the impact of different types of provision on young children's cognitive gains.

It has been shown that quality, qualifications and ratios differ for settings drawn from the six types of provision studied. In addition to statutory ratios, two measures of observed ratios with and without volunteers (based on typical ratios observed by field officers in individual centres) were tested. Ratios tended to be higher (i.e. more children per adult) in some forms of provision that had more highly qualified staff and higher ratings for quality. In testing the possible effects of ratios it is important to control for both type and quality of provision. The analyses found that better ratios (more staff to children) were significantly associated with progress in early number concepts but not other cognitive areas. It is concluded that it is probably most appropriate to consider 'packages' of pre-school provision in terms of qualifications of staff, ratios and quality of provision, rather than to consider particular aspects such as ratios in isolation.

Significant variations in centre managers' qualification levels have been shown to exist amongst the EPPE sample, and the proportion of staff hours at different qualification levels also varies. Centre managers' qualification levels are significantly associated with the observed quality profiles of centres (EPPE Technical Paper 6), with centres where managers reported they had level 5 qualifications (trained teachers) showing higher quality. Findings from the Researching Effective Pedagogy in the Early Years study also indicate that the observed behaviour of other staff is positively influenced by the presence of a member of staff with level 5 qualifications (see Siraj-Blatchford et al, 2002a). The multilevel analyses of children's progress showed one significant positive relationship with qualifications. Controlling for the impact of child parent and home environment influences, including prior attainment, a significant positive relationship between the percentage of level 5 staff hours and progress in pre-reading was identified. This indicates a link between more highly qualified (i.e. qualified teacher) staff and better child outcomes in pre-reading.

Children who had no pre-school centre experience

Data were collected for a group of 'home' children with none or only minimal pre-school centre experience (less than 10 weeks registered for 2 or fewer sessions a week) . Comparison of this 'home' sample with the EPPE sample showed that the characteristics and attainments of home children vary significantly. It is not possible to conclude with certainty that the much lower attainments of the 'home' group are directly due to lack of pre-school experience, due to their very different characteristics. A controlled experiment (which would not be feasible on ethical or practical grounds) would be needed to draw firm conclusions. Nonetheless, contextualised multilevel analyses of attainment at entry to primary school, which explore the impact of child, parent and home environment factors, illustrate that even when these important influences are controlled, home children's cognitive attainments are much poorer than those of children in the EPPE sample who had attended any of the six types of provision studied. This result, combined with the findings reported earlier on the advantages of an early start date and on 'duration' of pre-school, strongly suggests that pre-schooling has a positive impact on young children's cognitive attainment and progress. The implication of these results is that children without pre-school centre experience may be at a cognitive disadvantage when they start primary school.

Indeed, analyses conducted on the EPPE data sets which explore 'at risk' status in relation to special educational needs indicate that home children are over-represented in the cognitive 'at

risk' category, compared with other EPPE children, even when the level of multiple disadvantage is held constant (EYTSEN Technical Papers 1 and 2). In further analyses of children identified as 'at risk' of SEN because of low cognitive scores at entry to the study, children who are multiply disadvantaged show much better attainment levels than similarly disadvantaged children in the home sample. Again this finding points to the positive impact of pre-school experience on cognitive development. Thus pre-school experience may be especially beneficial for disadvantaged groups of children who show low cognitive attainments at age 3 years. As noted earlier, for children who attended a target pre-school in the study there was a significant reduction in the proportion 'at risk' of SEN in terms of low cognitive scores by start of primary school.

Equivalent analyses of young children's social behavioural development have been conducted for the EPPE study. The results are reported separately in Technical Paper 8b. Case studies of more effective centres (in terms of children's both cognitive and social behavioural development) have been conducted to explore in depth different aspects of pre-school organisation and practice which may illuminate the quantitative findings on the impact of pre-school and variations in centre effectiveness (see EPPE Technical Paper 10). Further analyses will explore the progress of the main EPPE sample and the home group over Key Stage 1. Such analyses will help to establish whether the positive impact of attending a pre-school centre on young children's cognitive progress remains significant as children move through their first years at primary school. These analyses will also investigate whether the achievement gap for vulnerable groups of children increases or decreases as they move through school.

The EPPE study is the first English, non-experimental longitudinal study of naturally occurring variation in the effectiveness of pre-school centres and their impact on young children's developmental outcomes. It has explored the influence of a number of important measures, including type of provision, observed quality and duration, as well as the effectiveness of individual centres. The findings are generally in line with those recently reported from the National Institute of Child Health and Development (NICHD) study of early child-care and children's development prior to school entry in the US (NICHD Early Child Care Research Network, 2002). However the NICHD latter study did not employ an educational effectiveness design and so could not investigate the impact of individual pre-school centres. The NICHD research points to the strength and relative independence of quantity, quality and type of child care for children's development. '*It is important that each of these aspects (quantity, quality and type) was associated with child functioning when other aspects of child care were controlled'* (NICHD, 2002; p157). The results at age 4 1/2 years were found to be consistent with those at age 36 months. In addition, the NICHD study also underscores the importance of parenting and home environment. Again the EPPE results point to the strength of the home learning environment as an independent influence on cognitive attainment at age three and rising 5 years and also on progress during the pre-school period. The NICHD study, however, reports that it has some limitations in relation to the detecting the strength of both child care and parenting effects because the sampling plan excluded some high risk families (NICHD, 2002; p158) leading to truncated scores at the lower end. The EPPE study sought to include children from the full range of provision, plus an additional group of home children in the design. This is likely to improved the ability to measure pre-school effects. In addition, the use of 141 centres as the basis for recruiting the child sample means that it is possible to use multilevel models to separate variance in cognitive attainment to detect individual pre-school centre effects.

Another US study that has provided recent evidence on the continuing impact of pre-school experience is the Cost, Quality and Outcomes CQO Study (Peisner-Feinberg et al, 2000).[59] This study began in 1993 and followed children from centre-based pre-school provision through into elementary school. It did not explore the effectiveness of individual centres but reports important findings on the importance of centre quality (using the ECERS-R and CIS measures) especially for children whose mothers had lower levels of education. The positive impact of quality was

[59] See http://www.fpg.unc.edu/~NCEDL/PAGES/cqes.htm

found to influence cognitive development through early elementary school. It was concluded that high quality child-care experiences, in terms of both classroom practices and teacher—child relationships, enhance children's abilities to take advantage of the educational opportunities in school.

The correspondence in findings on the importance of early child care between the EPPE and both the NICHD and CQO studies, which were conducted in a different context (the US) independently and using different research designs, suggests that the conclusions concerning the impact of child care quantity and quality are robust. The EPPE study goes further, however, by examining variation in the effectiveness of *individual* pre-school centres using an educational effectiveness design, as well as investigating differences related to type and a range of process measures including quality, qualifications and ratios.

Appendix A

Chart A.1 Number of EPPE children in pre-school centres

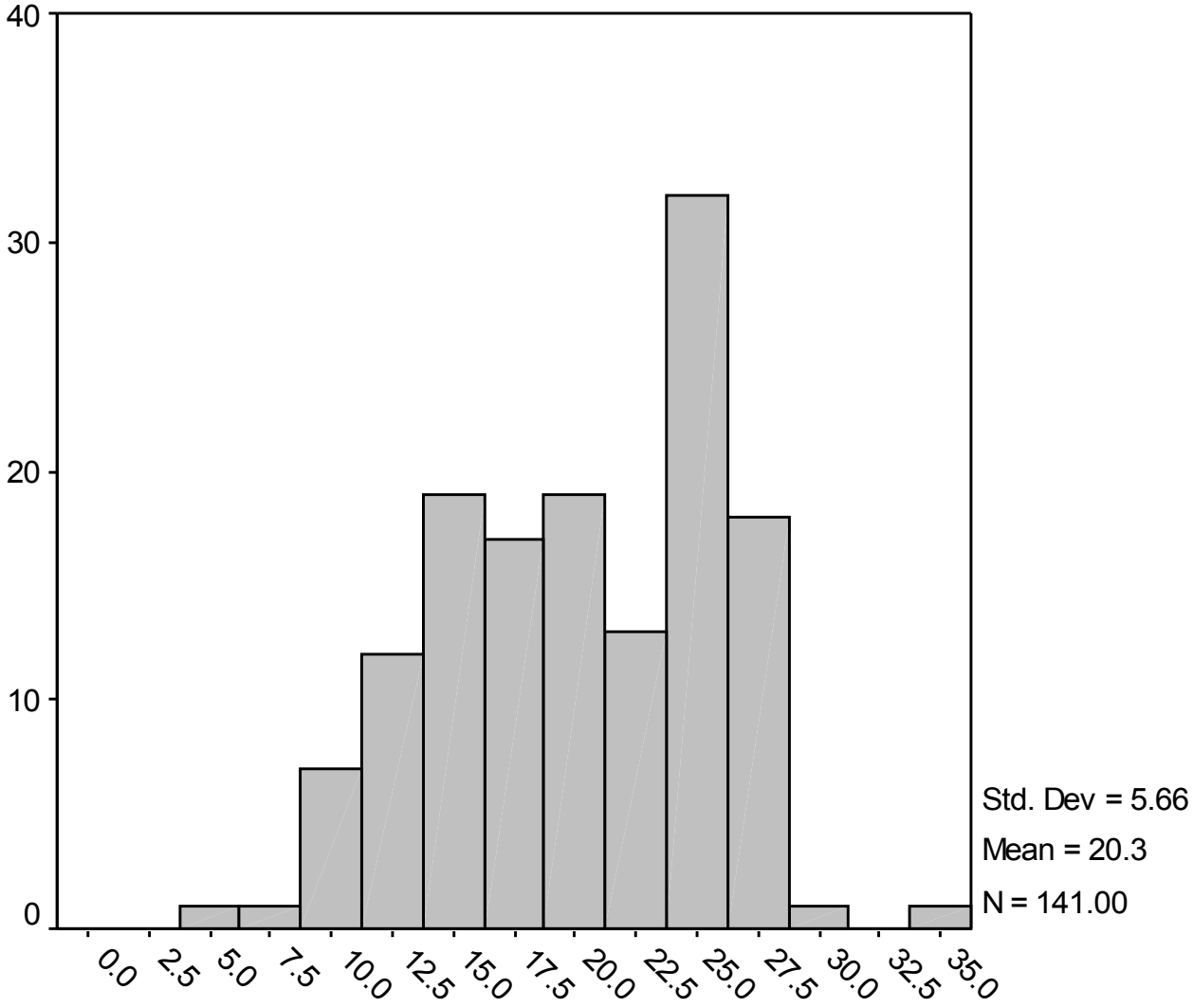


Chart A.2 Distribution of the pre-reading composite

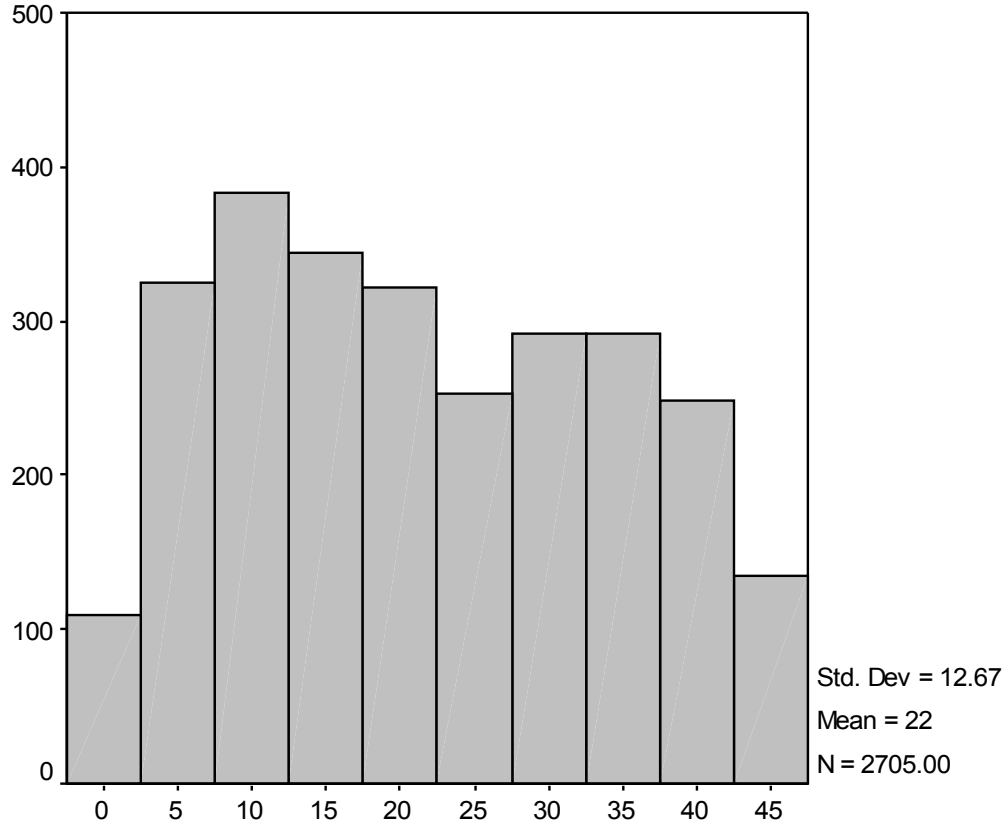


Chart A.3 Distribution of the letter recognition sub-scale (of the pre-reading composite)

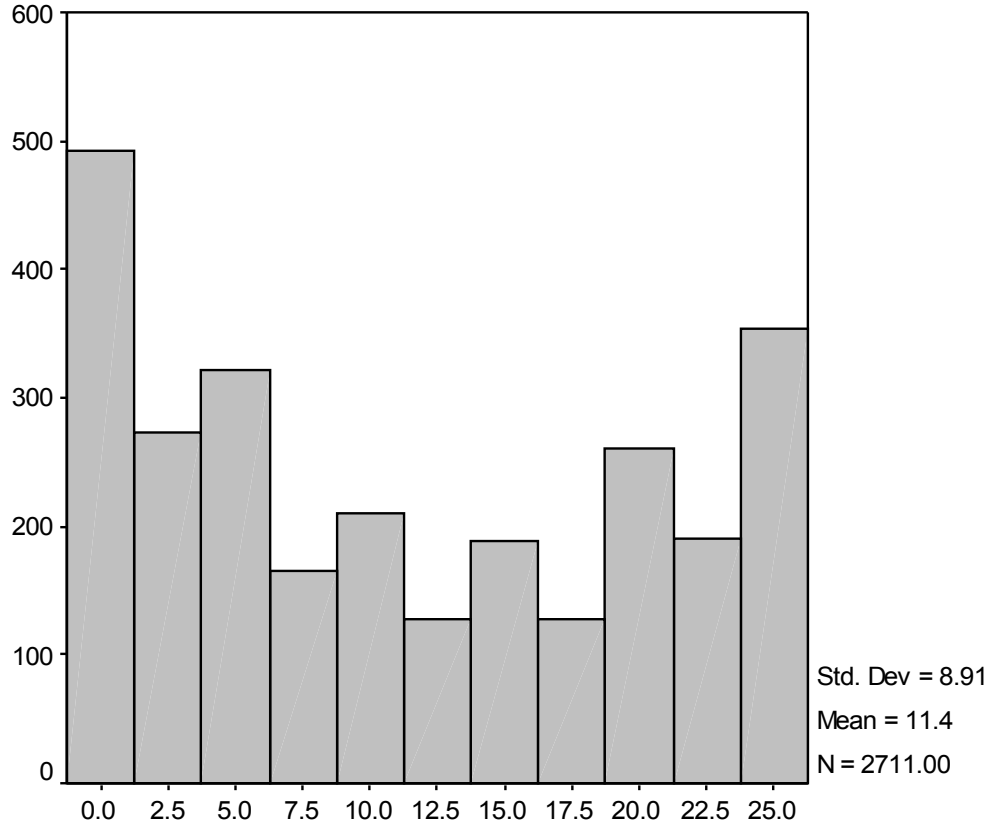


Chart A.4 Distribution of the rhyme sub-scale (of the pre-reading composite)

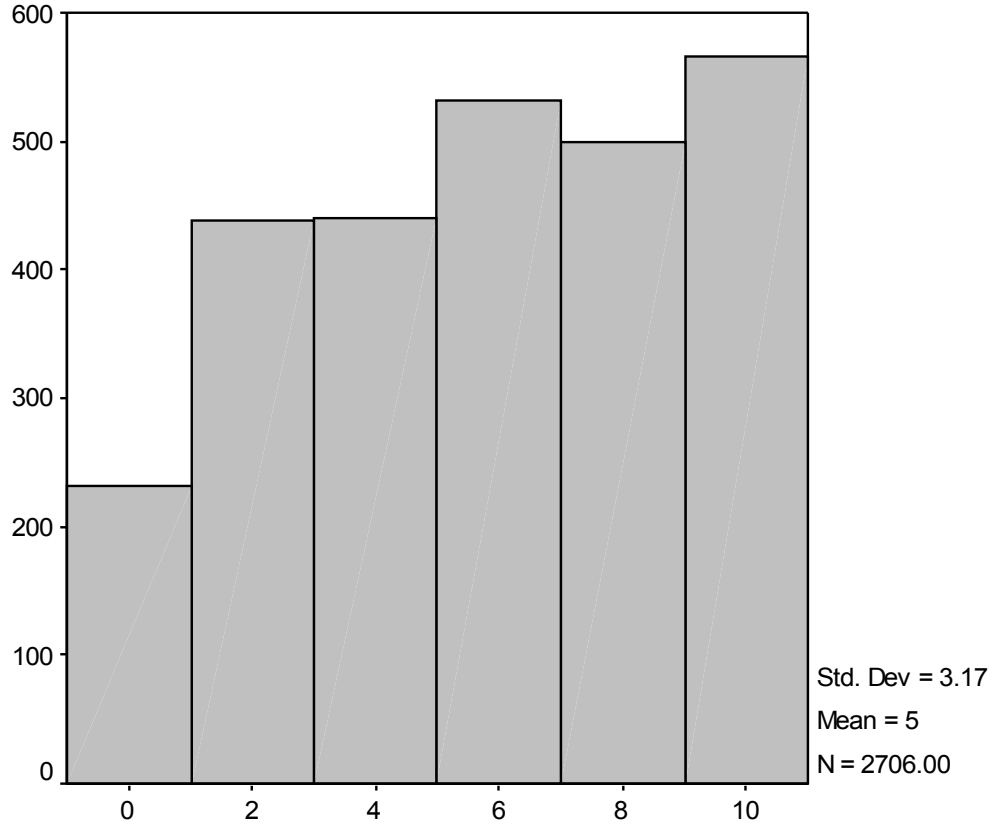


Chart A.5 Distribution of the alliteration sub-scale (of the pre-reading composite)

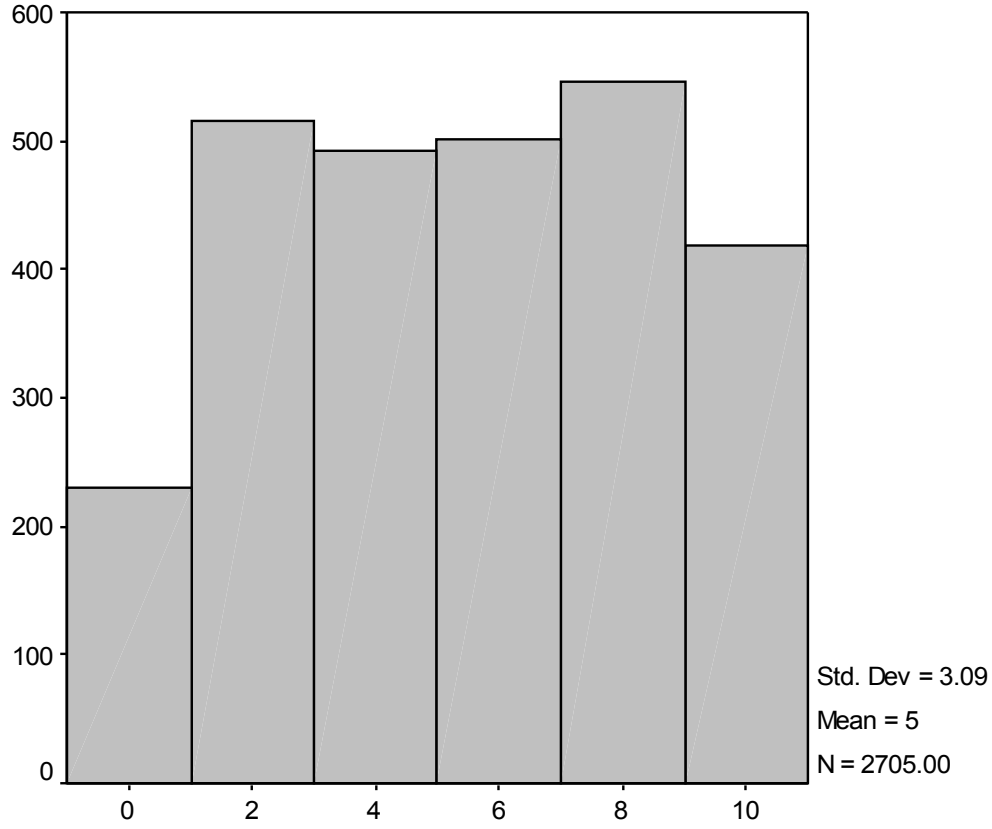


Chart A.6 Distribution of the early numbers concepts outcome

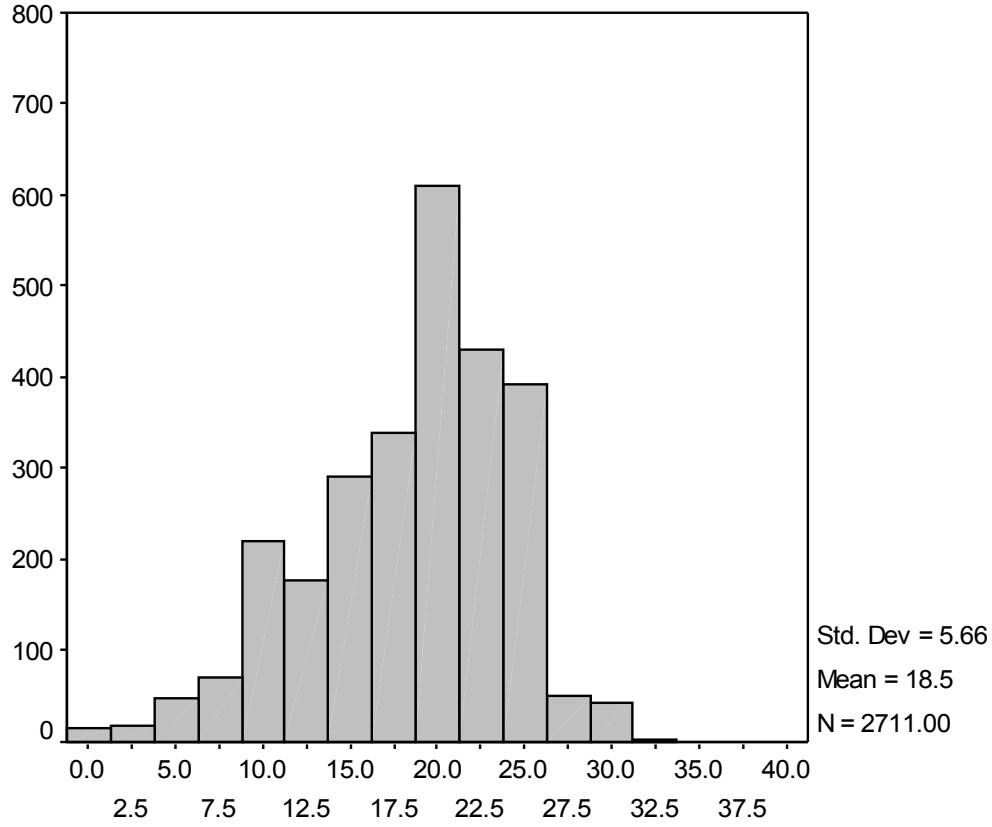


Chart A.7 Distribution of the language composite

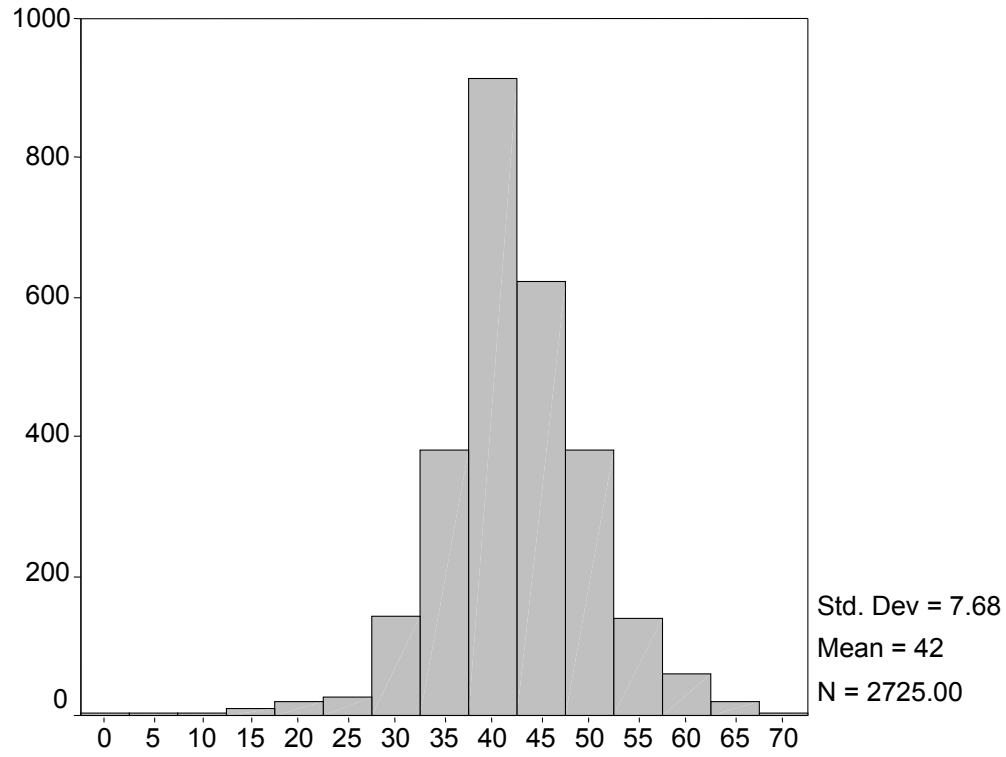


Chart A.8 Distribution of the non-verbal reasoning outcome

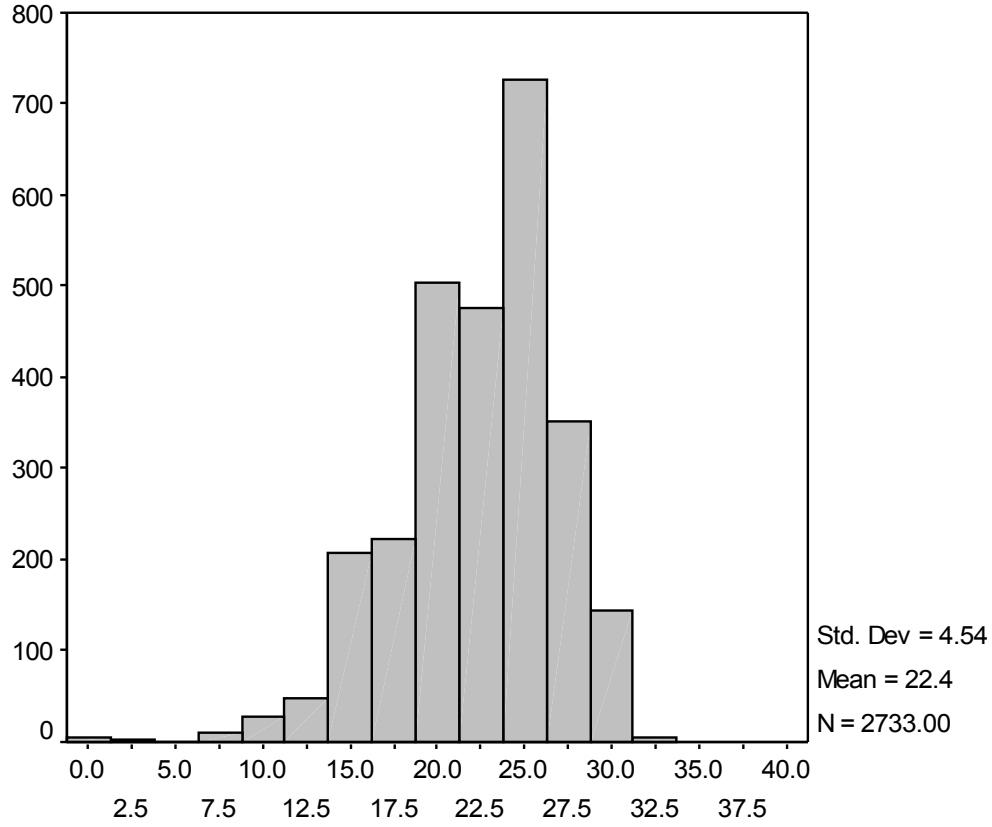


Chart A.9 Distribution of the spatial reasoning/awareness outcome

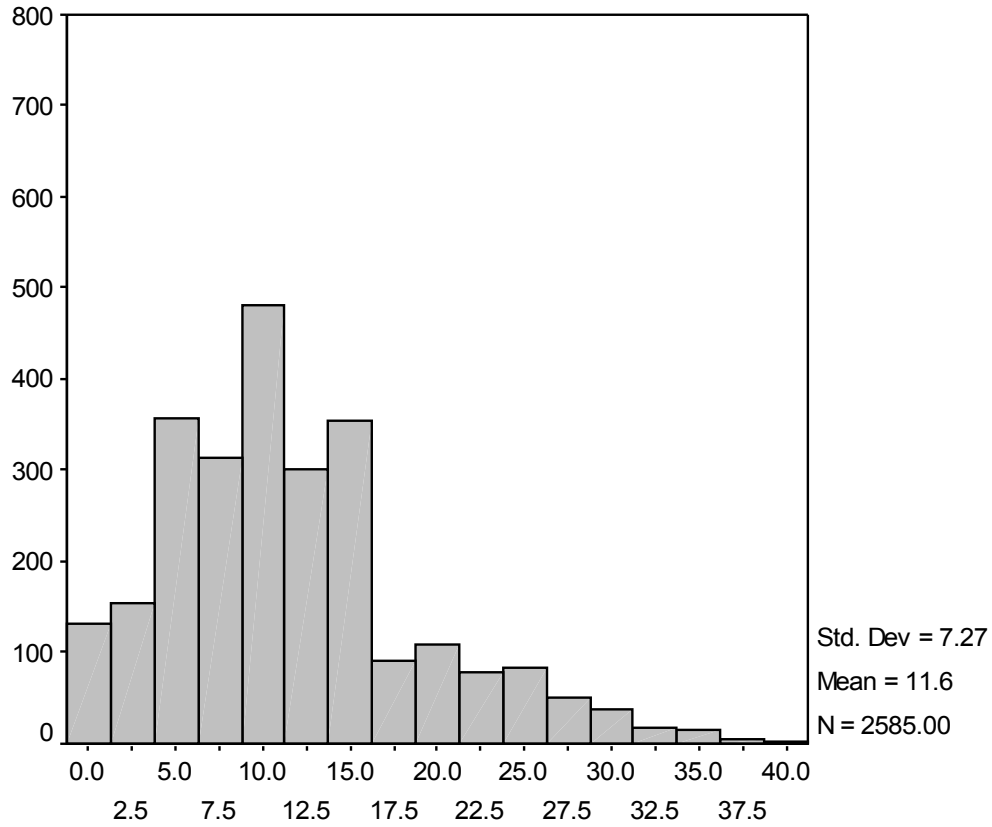


Chart A.10 Pre-reading composite versus early number concepts

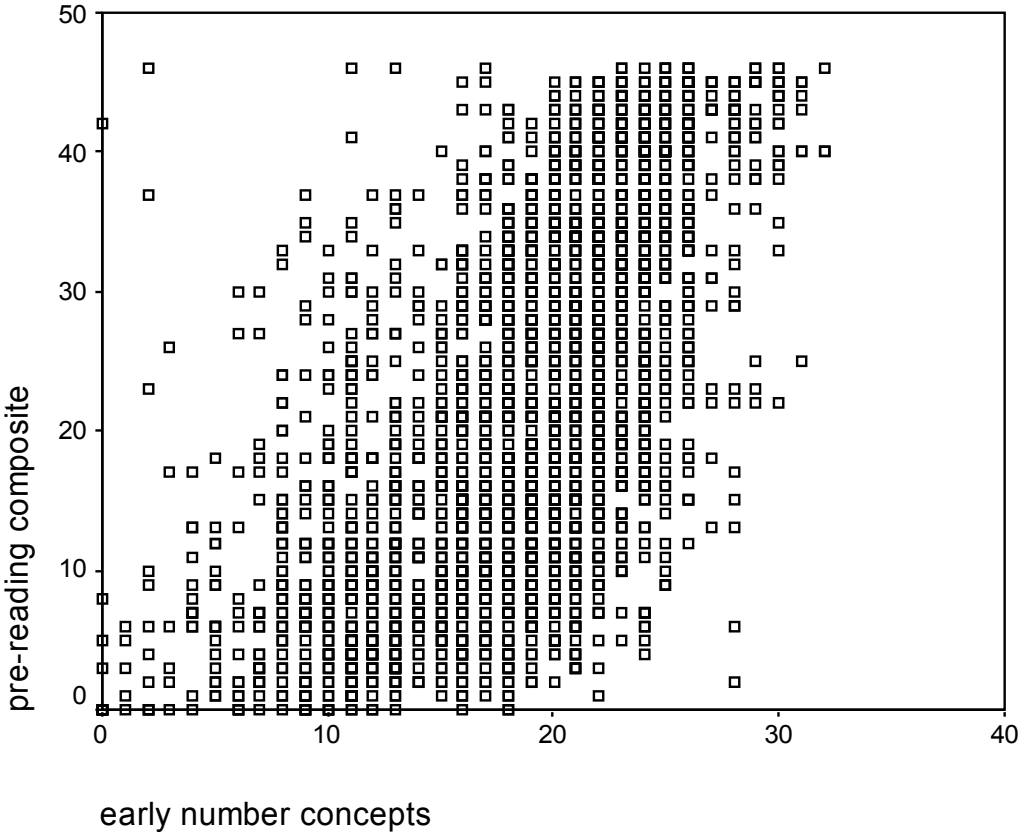
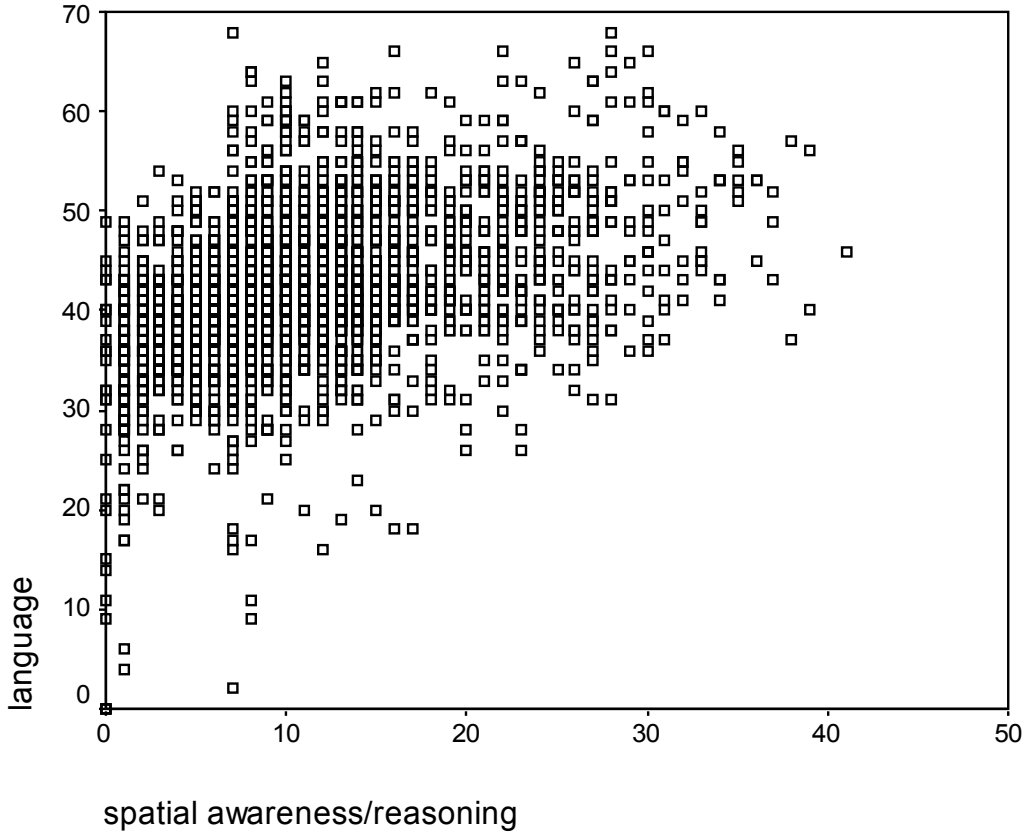


Chart A.11 Language versus spatial awareness/reasoning



Appendix B

Table B.1 Pre-Reading Contextualised Model

(Impact of Child, Parent, Home Learning Environment and other Measures on Pre-reading Attainment at Entry to Primary School)

		Estimate	SE
Gender (girls compared to boys)		2.511*	0.402
Age at outcome test (centred around mean)		0.758*	0.064
Ethnicity (compared to white UK)	White European	-3.799*	1.084
	Black Caribbean	1.536	1.150
	Black African	4.221*	1.485
	Black other	3.654	2.599
	Indian	3.043	1.669
	Pakistani	-1.602	1.540
	Bangladeshi	-0.934	2.711
	Other	-0.566	1.503
	Mixed	0.776	0.848
No. of siblings (compared to none)	1-2	-0.428	0.511
	3+	-2.816*	0.747
Birthweight (compared to average/above average)	very low	-4.276*	1.711
	low	-1.754*	0.804
Free School Meal Eligibility (compared to not eligible)		-1.611*	0.574
Mother's highest level of qualification (compared to no qualifications)			
	vocational	0.325	0.759
	academic age 16	1.243	0.643
	academic age 18	2.225*	0.926
	degree	3.841*	0.953
	higher	4.970*	1.374
	other	5.729*	1.755
Family SES (compared to professional non-manual)	intermediate non-manual	-1.536	0.837
	skilled non-manual	-2.493*	0.953
	skilled manual	-2.595*	1.090
	semi-skilled manual and unskilled manual	-3.318*	1.101
	never worked	-2.741	1.707
Father's highest level of qualification (compared to no qualifications)			
	vocational	1.190	0.828
	academic age 16	0.971	0.723
	academic age 18	1.420	0.954
	degree	2.084*	0.943
	higher	1.822	1.300
	other	-0.695	2.077
	absent father	0.088	0.707
Frequency parent reads to child (compared to daily)	rarely	-1.168	1.244
	weekly	-1.698	1.378
	several times a week	-0.917	0.523
	twice daily	1.496*	0.666
Frequency of library visits (compared to never)	special occasions	-0.251	0.705
	monthly	0.979	0.600
	fortnightly	1.332#	0.671
	weekly	1.472*	0.704
Frequency parent teaches letters/numbers (compared to daily)	never	-3.374*	0.690
	1-2 times a week	-1.970*	0.585
	3-4 times a week	-1.729*	0.594
	5-6 times a week	-0.372	0.757
Frequency parent teaches abc (compared to never)	1-2 times a week	2.851*	0.668
	3 times a week	5.917*	0.774
	4-7 times a week	6.063*	0.783
Developmental problems (compared to none)	1 developmental problem	-2.543*	0.643
	2 + developmental problems	-4.118*	1.815
Number of non-parental carers (compared to only parental carers)			
	1 non-parental carer	0.994*	0.495

2 non-parental carers	1.528*	0.602
3 non-parental carers	0.992	0.884
4+ non-parental carers	2.614*	1.167
Duration of pre-school (centred around mean)	0.093*	0.025
Duration of reception (centred around mean)	0.845*	0.324
% of children in centre with mothers who have a degree or higher (centred around mean)	0.070*	0.018

*Statistically significant at 0.05 level [#] Just failed to reach statistical significance at 0.05 level

Table B.2 Early Number Concepts Contextualised Model
(Impact of Child, Parent, Home Learning Environment and other Measures on Early Number Concepts Attainment at Entry to Primary School)

		Estimate	SE
Gender (girls compared to boys)		0.670*	0.191
Age at outcome test (centred around mean)		0.526*	0.029
Ethnicity (compared to white UK)	White European	-0.727	0.532
	Black Caribbean	-0.073	0.521
	Black African	-0.777	0.689
	Black other	0.180	1.199
	Indian	0.888	0.803
	Pakistani	-2.562*	0.786
	Bangladeshi	-1.364	1.268
	other	0.138	0.741
	mixed	0.031	0.392
No. of siblings (compared to none)	1-2	-0.151	0.233
	3+	-0.931*	0.338
Birthweight (compared to average/above average)	very low	-3.023*	0.791
	low	-0.644#	0.370
English as an additional language (compared to English as mother tongue)		-1.733*	0.536
Free School Meal Eligibility (compared to not eligible)		-0.825*	0.256
Mother's highest level of qualification (compared to no qualifications)			
	vocational	0.326	0.344
	academic age 16	0.812*	0.290
	academic age 18	1.167*	0.419
	degree	1.293*	0.419
	higher	1.614*	0.582
	other	1.361	0.812
Family SES (compared to professional non-manual)	intermediate non-manual	-0.485	0.368
	skilled non-manual	-1.218*	0.409
	skilled manual	-1.318*	0.472
	semi-skilled manual and unskilled manual	-2.572*	0.474
	never worked	-1.214	0.763
Frequency parent reads to child (compared to daily)	rarely	-0.703	0.578
	weekly	-1.537*	0.638
	several times a week	-0.180	0.241
	twice daily	0.101	0.308
Frequency of library visits (compared to never)	special occasions	0.437	0.326
	monthly	0.881*	0.277
	fortnightly	0.765*	0.311
	weekly	0.742*	0.325
Frequency parent teaches letters/numbers (compared to daily)	never	-0.746*	0.323
	1-2 times a week	-0.372	0.272
	3-4 times a week	-0.292	0.277
	5-6 times a week	-0.057	0.350
Frequency child paints/draws at home (compared to never)	1-4 times a week	1.118*	0.503
	5-7 times a week	1.521*	0.507
Frequency parent teaches abc (compared to never)	1-2 times a week	0.933*	0.309
	3 times a week	1.239*	0.357
	4-7 times a week	1.576*	0.361
Developmental problems (compared to none)	1 developmental problem	-1.538*	0.297
	2 + developmental problems	-1.694*	0.839
Duration of pre-school (centred around mean)		0.031*	0.011
% of children in centre with mothers who have a degree or higher (centred around mean)		0.021*	0.008

***** Statistically significant at 0.05 level **#** Just failed to reach statistical significance at 0.05 level

Table B.3 Language Contextualised Model
(Impact of Child, Parent, Home Learning Environment and other Measures on Language Attainment at Entry to Primary School)

		Estimate	SE
Age at outcome test (centred around mean)		0.390*	0.032
Ethnicity (compared to white UK)	White European	-2.470*	0.662
	Black Caribbean	-2.375*	0.639
	Black African	-2.544*	0.855
	Black other	-1.432	1.497
	Indian	-2.290*	0.979
	Pakistani	-4.935*	0.969
	Bangladeshi	-5.383*	1.573
	other	-2.594*	0.913
	mixed	-1.637*	0.485
No. of siblings (compared to none)	1-2	-0.402	0.289
	3+	-1.489*	0.424
Birthweight (compared to average/above average)	very low	-2.729*	0.978
	low	-0.408	0.467
English as an additional language (compared to English as mother tongue)		-4.964*	0.669
Free School Meal Eligibility (compared to not eligible)		-0.663*	0.320
Mother's highest level of qualification (compared to no qualifications)	vocational	0.165	0.429
	academic age 16	0.789*	0.362
	academic age 18	1.549*	0.523
	degree	3.041*	0.526
	higher	3.302*	0.724
	other	0.041	1.003
Family SES (compared to professional non-manual)	intermediate non-manual	-0.336	0.461
	skilled non-manual	-1.386*	0.510
	skilled manual	-1.708*	0.589
	semi-skilled manual and unskilled manual	-2.811*	0.593
	never worked	-4.088*	0.939
Frequency parent reads to child (compared to daily)	never /rarely	-1.413#	0.721
	weekly	-2.143*	0.789
	several times a week	-0.790*	0.301
	twice daily	0.564	0.384
Frequency of library visits (compared to never)	special occasions	0.438	0.407
	monthly	0.953*	0.345
	fortnightly	1.615*	0.389
	weekly	1.031*	0.405
Frequency parent teaches abc (compared to never)	1-2 times a week	1.187*	0.384
	3 times a week	1.852*	0.447
	4-7 times a week	1.852*	0.454
Frequency child play with friends at home (compared to never)	< once a week	0.619	0.707
	1-2 times a week	0.603*	0.279
	3-4 times a week	-1.022*	0.380
	5-7 times a week	-0.169	0.399
Frequency parent teaches songs, poems and nursery rhymes (compared to never)	1-2 times a week	0.777	0.496
	3-5 times a week	1.949*	0.473
	6 times a week	2.111*	0.502
	7+ times a week	1.791*	0.503
Developmental problems (compared to none)	1 developmental problem	-1.910*	0.367
	2 + developmental problems	-2.651*	1.050
Number of non-parental carers (compared to only parental carers)			
	1 non-parental carer	0.493	0.285
	2 non-parental carers	0.639	0.347
	3 non-parental carers	1.433*	0.511
	4+ non-parental carers	0.246	0.675
Duration of pre-school (centred around mean)		0.031*	0.013
% of children in centre with mothers with a degree or higher (centred around mean)		0.029*	0.009

*Statistically significant at 0.05 level # Just failed to reach statistical significance at 0.05 level

Effect Sizes

Effect sizes (ES) are most commonly used in experimental studies where there is a control group and an experimental group. Following Glass et al (1981), the effect size can be defined as:

ES = (mean of experimental group)-(mean of control group)/pooled standard deviation

or $$\Delta = \frac{\bar{X}_{Exp} - \bar{X}_{Cont}}{SD_{pooled}}$$

The EPPE study is not an experimental study, rather it explores naturally occurring variation in pre-school provision and, in particular, pre-school centre effects. It employs multilevel models to separate pre-school centre level variance in child outcome measures from that attributable to differences at the individual child level, recognising the hierarchical nature of the data (Goldstein, 1995). Effect size is essentially a mean difference involving the 'fixed' part of the model. Thus, the above equation would be suitable even if the means were derived from the multilevel model. Furthermore, in a multilevel model, the (standardised) between-school variance of an effect can also be estimated.

In this technical paper, effect sizes have been calculated for a number of contextualised and value added models, using both the child level variance[60] and coefficients from the multilevel statistical models. The formulae used for the categorical and continuous variables are detailed below and have the advantage of being relatively quick to calculate and readily understandable. For categorical predictor variables, the effect size has been calculated following Tymms et al (1997) (a method also used by Strand, 2002):

ES = categorical predictor variable coefficient / √child level variance

or $$\Delta = \frac{\beta_1}{\sqrt{\sigma_e}}$$

For continuous predictor variables, the effect size has been taken as follows and describes the change on the outcome measure that will be produced by a change of one standard deviation on the continuous predictor variable, standardised by the within school SD adjusted for covariates in the model – the level 1 SD:

*ES = continuous predictor variable coefficient*SD continuous predictor variable / √child level variance*

or $$\Delta = \frac{\beta_1 * sd_{x1}}{\sqrt{\sigma_e}}$$ where $_{x1}$=continuous predictor variable

Charts showing effect sizes for both categorical and continuous predictor variables have been produced providing an indication of the relative magnitude or importance of potential predictor (explanatory) variables. It is important to note that the charts displaying effect sizes for the two types of variables are not directly comparable and that effect sizes do not give an indication of statistical significance of particular predictors (information about this is provided in accompanying tables which show the multilevel estimates and their associated standard errors). Effect sizes for some categorical measures are large but may only apply to very small numbers of children (e.g. the very low birthweight group or specific ethnic groups) and may not always be statistically significant. Effect sizes for continuous measures may appear relatively modest but generally apply to all children.

When interpreting effect sizes, Coe (2002) reports the danger of using terms like 'small', 'medium' and 'large' stating that,

[60] Using the child level variance from the multilevel models (i.e. amount of variation in the outcome measure attributable to the individual child after controlling for prior attainment in value added models and other significant background characteristics in contextualised and value added models) tends to increase the effect size compared to calculations which use a raw standard deviation (i.e. amount of variation in the outcome measure before controlling for prior attainment, etc).

'Glass et al (1981, p104) are particularly critical of this approach, arguing that the effectiveness of a particular intervention can only be interpreted in relation to other interventions that seek to produce the same effect. They also point out that the practical importance of an effect depends entirely on its relative costs and benefits. In education, if it could be shown that making a small and inexpensive change would raise academic achievement by an effect size of even as little as 0.1, then this could be a very significant improvement, particularly if the improvement applied uniformly to all students, and even more so if the effect were cumulative over time.' Coe (2002)

Effect sizes can be useful for comparisons between studies but interpretations must be made with caution and with reference to the outcomes concerned.

The influence of different categorical predictor variables (child, family, home learning environment characteristics, etc.) in the contextualised models described in Section 2 and 5 illustrate the impact on attainment at a given point in time (entry to primary school). These effect sizes are generally considerably larger than those identified in the value added analyses (reported in Section 3 and 4) which measure children's cognitive progress over time in pre-school. This is because of the strong relationships with prior attainment (at entry to the study at age 3 plus years) which is controlled in the models of progress.

Further analyses are planned which will investigate effect sizes further by means of the calculation of confidence limits. This will aid interpretation of effect sizes for predictor measures relating to small sub-groups of children in particular (see discussion by Coe, 2002).

Appendix C

Table C.1 Pre-Reading Complex Value Added Model

(Impact of prior attainment, child, parent, home environment and other composition of intake measures on pre-reading progress over the pre-school period)

		Estimate	SE
Prior verbal attainment (centred around mean)(note that a squared term is also significant)		0.217*	0.014
Prior non-verbal attainment (centred around mean)		0.095*	0.014
Gender (girls compared to boys)		1.871*	0.372
Age at outcome test (centred around mean)		0.649*	0.068
Ethnicity (compared to white UK)	White European	-1.470	1.110
	Black Caribbean	2.900*	1.055
	Black African	6.230*	1.410
	Black other	5.122*	2.389
	Indian	4.617*	1.663
	Pakistani	1.352	1.714
	Bangladeshi	3.939	2.725
	other	0.808	1.588
	mixed	1.999*	0.795
No. of siblings (compared to none)	1-2	-0.106	0.467
	3+	-1.355#	0.686
English as an additional language (compared to English as mother tongue)		2.996*	1.208
Birthweight (compared to average/above average)	very low	-2.021	1.610
	low	-1.645*	0.753
Free School Meal Eligibility (compared to not eligible)		-1.041*	0.521
Mother's highest level of qualification (compared to no qualifications)			
	vocational	0.180	0.692
	academic age 16	0.745	0.587
	academic age 18	1.860*	0.843
	degree	2.242*	0.842
	higher	3.732*	1.164
	other	4.736*	1.588
Family SES (compared to professional non-manual)	intermediate non-manual	-1.647*	0.730
	skilled non-manual	-2.162*	0.813
	skilled manual	-2.123*	0.940
	semi-skilled manual and unskilled manual	-2.401*	0.949
	never worked	-2.756	1.536
Frequency parent teaches letters/numbers (compared to daily)	never	-3.165*	0.637
	1-2 times a week	-1.857*	0.538
	3-4 times a week	-1.487*	0.548
	5-6 times a week	-0.337	0.700
Frequency parent teaches abc (compared to never)	1-2 times a week	1.991*	0.622
	3 times a week	4.575*	0.719
	4-7 times a week	4.539*	0.731
Change of pre-school (compared to no change)		-1.078*	0.538
Duration of pre-school (centred around mean)		0.301*	0.058
Duration of reception (centred around mean)		1.278*	0.306
% of children in centre 1sd below GCA mean (centred around mean)		-0.043#	0.024
% of children in centre with mothers who have a degree or higher (centred around mean)		0.055*	0.018

*Statistically significant at 0.05 level # Just failed to reach statistical significance at 0.05 level

Table C.2 Early Number Concepts Complex Value Added Model
(Impact of prior attainment, child, parent, home environment and other measures on early number concepts progress over the pre-school period)

		Estimate	SE
Prior verbal attainment (centred around mean)		0.079*	0.006
Prior non verbal attainment (centred around mean) (note that a squared term is also significant)		0.079*	0.006
Gender (girls compared to boys)		0.374*	0.172
Age at outcome test (centred around mean)		0.501*	0.030
Ethnicity (compared to white UK)	White European	0.158	0.478
	Black Caribbean	0.338	0.467
	Black African	-0.374	0.629
	Black other	0.479	1.079
	Indian	0.874	0.678
	Pakistani	-1.324#	0.666
	Bangladeshi	0.315	1.125
	other	0.096	0.666
	mixed	0.273	0.355
Birthweight (compared to average/above average)	very low	-1.886*	0.731
	low	-0.388	0.336
Mother's highest level of qualification (compared to no qualifications)			
	vocational	0.222	0.307
	academic age 16	0.567*	0.259
	academic age 18	0.921*	0.374
	degree	0.485	0.375
	higher	0.740	0.522
	other	1.271	0.727
Family SES (compared to professional non-manual)	intermediate non-manual	-3.70	0.328
	skilled non-manual	-0.734*	0.364
	skilled manual	-0.805	0.420
	semi-skilled manual	-1.703*	0.428
	unskilled manual	-0.874	0.692
	never worked	-0.665	0.686
Frequency child paints/draws at home (compared to never)	1-4 times a week	1.254*	0.451
	5-7 times a week	1.430*	0.455
Frequency parent teaches letters/numbers (compared to daily)	never	-0.671*	0.289
	1-2 times a week	-0.416	0.243
	3-4 times a week	-0.283	0.247
	5-6 times a week	-0.206	0.315
Frequency parent teaches abc (compared to never)	1-2 times a week	0.479	0.280
	3 times a week	0.489	0.323
	4-7 times a week	0.822*	0.327
Development problems (compared to none)	1 developmental problem	-0.721*	0.268
	2+ developmental problems	-0.495	0.819
Change of pre-school (compared to no change)		-0.226	0.236
Duration of pre-school (centred around mean)		0.095*	0.025
% of children in centre with mothers who have a degree or higher (centred around mean)		0.016*	0.007

***** Statistically significant at 0.05 level # Just failed to reach statistical significance at 0.05 level

Table C.3 Language Complex Value Added Model
(Impact of prior attainment, child, parent, home environment and other measures on language progress over the pre-school period)

		Estimate	SE
Prior verbal attainment (centred around mean)		0.194*	0.007
Prior non verbal attainment (centred around mean)		0.049*	0.007
Age at outcome test (centred around mean)		0.399*	0.032
Ethnicity (compared to white UK)	White European	-0.359	0.560
	Black Caribbean	-1.324*	0.521
	Black African	-0.938	0.709
	Black other	0.012	1.166
	Indian	-1.323	0.803
	Pakistani	-2.763*	0.828
	Bangladeshi	-1.877	1.393
	other	-1.407	0.783
	mixed	-0.753	0.403
No.of siblings (compared to none)	1-2	-0.415	0.237
	3+	-0.810*	0.348
English as an additional language (compared to English as mother tongue)		-1.122*	0.590
Mother's highest level of qualification (compared to no qualifications)			
	vocational	-0.485	0.352
	academic age 16	0.071	0.297
	academic age 18	0.588	0.431
	degree	1.129*	0.431
	higher	1.557*	0.598
	other	-0.835	0.809
Family SES (compared to professional non-manual)	intermediate non-manual	0.017	0.378
	skilled non-manual	-0.602	0.420
	skilled manual	-0.564	0.483
	semi-skilled manual	-1.087*	0.494
	unskilled manual	-1.284	0.778
	never worked	-2.802*	0.775
Frequency reading to child (compared to daily)	rarely	-1.274*	0.61
	weekly	-1.070	0.639
	several	-0.551*	0.245
	twice daily	0.001	0.318
Frequency of library visits (compared to never)	on special occasions	0.408	0.333
	monthly	0.296	0.283
	fortnightly	0.846*	0.323
	weekly	0.287	0.338
Frequency parent teaches songs, poems and nursery rhymes (compared to never)			
	1-2 times a week	0.233	0.406
	3 times a week	0.936*	0.388
	4-6 times a week	0.805#	0.410
	7+ times a week	0.681	0.408
Frequency child play with friends at home (compared to never)			
	1-2 times a week	0.164	0.226
	3-7 times a week	-0.622*	0.255
Change of pre-school (compared to no change)		0.253	0.268
Duration of pre-school (centred around mean)		0.068*	0.027
% of children in centre with mothers who have a degree or higher (centred around mean)		0.022*	0.007

*Statistically significant at 0.05 level # Just failed to reach statistical significance at 0.05 level

Table C.4 Non-Verbal Reasoning Value Added Model
(Impact of prior attainment, child, parent, home environment and other measures on non-verbal reasoning progress over the pre-school period)

		Estimate	SE
Prior verbal attainment (centred around mean)		0.038*	0.005
Prior non verbal attainment (centred around mean)		0.073*	0.006
Gender (girls compared to boys)		0.358*	0.149
Age at outcome test (centred around mean)		0.368*	0.024
Ethnicity (compared to white UK)	White European	0.471	0.423
	Black Caribbean	1.067*	0.403
	Black African	0.919	0.542
	Black other	0.445	0.908
	Indian	0.849	0.599
	Pakistani	-0.722	0.589
	Bangladeshi	0.921	0.997
	other	0.102	0.574
	mixed	0.317	0.313
Free School Meal Eligibility (compared to not eligible)		-0.424*	0.205
Mother's highest level of qualification (compared to no qualifications)			
	vocational	0.431	0.275
	academic age 16	0.193	0.233
	academic age 18	0.113	0.335
	degree	1.149*	0.330
	higher	0.631	0.454
	other	0.380	0.627
Family SES (compared to professional non-manual)	intermediate non-manual	-0.568	0.292
	skilled non-manual	-0.449	0.323
	skilled manual	-0.317	0.373
	semi-skilled manual	-0.468	0.382
	unskilled manual	-1.300*	0.606
	never worked	-1.645*	0.602
Change of pre-school (compared to no change)		-0.155	0.206
Duration of pre-school (centred around mean)		0.053*	0.021

*Statistically significant at 0.05 level #Just failed to reach statistical significance at 0.05 level

Table C.5 Spatial Awareness/Reasoning Complex Value Added Model
(Impact of prior attainment, child, parent, home environment, and other measures on spatial awareness/reasoning progress over the pre-school period)

		Estimate	SE
Prior verbal attainment (centred around mean)		0.019*	0.009
Prior non-verbal attainment (centred around mean)		0.143*	0.009
Age at outcome test (centred around mean)		0.686*	0.042
Ethnicity (compared to white UK)	White European	0.021	0.681
	Black Caribbean	0.330	0.645
	Black African	-0.290	0.879
	Black other	0.324	1.483
	Indian	0.156	0.946
	Pakistani	-0.423	0.918
	Bangladeshi	3.396*	1.636
	other	0.248	0.908
	mixed	-0.194	0.502
Birthweight (compared to average/above average)	very low	-2.404*	0.982
	Low	-0.613	0.492
Mother's highest level of qualification (compared to no qualifications)			
	vocational	0.794	0.422
	academic age 16	1.161*	0.356
	academic age 18	1.067*	0.512
	degree	2.249*	0.489
	higher	3.109*	0.686
	other	0.860	1.012
Change of pre-school (compared to no change)		-0.597	0.326
Duration of pre-school (centred around mean)		0.076	0.036
% of children in centre with mothers who have a degree or higher (centred around mean)		0.032*	0.009

*Statistically significant at 0.05 level # Just failed to reach statistical significance at 0.05 level

Table C.6 Complex Value Added Models in Five Cognitive Outcomes
(Impact of prior attainment, child, parent, home environment and other measures on cognitive progress over the pre-school period)

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness reasoning
Prior verbal attainment (centred around mean)	**positive**	**positive**	**positive**	**positive**	**positive**
Prior non-verbal attainment (centred around mean)	**positive**	**positive**	**positive**	**positive**	**positive**
Gender (girls compared to boys)	**positive**	**positive**		**positive**	
Age at outcome test (centred around mean)	**positive**	**positive**	**positive**	**positive**	**positive**
Ethnicity (compared to white UK)					
White European					
Black Caribbean	**positive**		**negative**	**positive**	
Black African	**positive**				
Black other	**positive**				
Indian	**positive**				
Pakistani		**negative**[#]	**negative**		
Bangladeshi					**positive**
other					
mixed	**positive**				
No. of siblings (compared to none) 1-2					
3+	**negative**[#]		**negative**		
English as an additional language (compared to English as mother tongue)	**positive**		**negative**		
Birthweight (compared to average/above average)					
very low		**negative**			**negative**
low	**negative**				
Free school meal eligibility (compared to not eligible)	**negative**			**negative**	
Mother's highest level of qualification (compared to no qualifications)					
vocational					
academic age 16		**positive**			**positive**
academic age 18	**positive**	**positive**			**positive**
degree	**positive**		**positive**	**positive**	**positive**
higher	**positive**		**positive**=		**positive**
other	**positive**				
Family SES (compared to professional non-manual)					
intermediate non manual	**negative**				
skilled non-manual	**negative**	**negative**			
skilled manual	**negative**				
semi-skilled manual	**negative** **	**negative**	**negative**		
unskilled manual				**negative**	
never worked			**negative**	**negative**	

[#] Just failed to reach statistical significance at 0.05 level
** the groups semi-skilled manual and unskilled manual have been combined

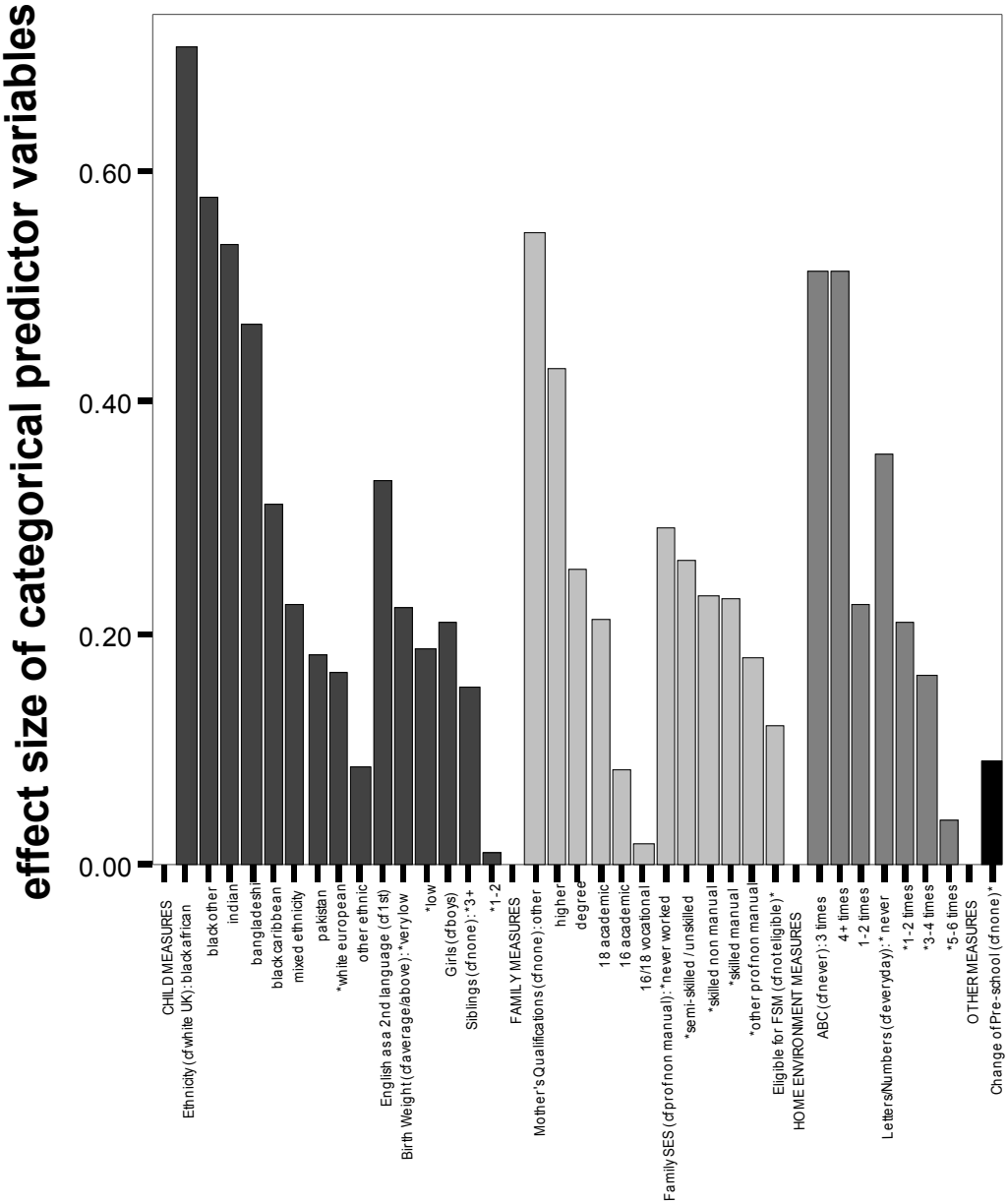
Table C.6 continued

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness reasoning
Frequency reading to child (compared to daily) rarely weekly several twice daily			**negative** **negative**		
Frequency of library visits (compared to never) on special occasions monthly fortnightly weekly			 **positive**		
Frequency child paints/draws at home (compared to never) 1-4 times a week 5-7 times a week		 **positive** **positive**			
Frequency parent teaches letters/numbers (compared to daily) never 1-2 times a week 3-4 times a week 5-6 times a week	 **negative** **negative** **negative**	 **negative**			
Frequency parent teaches abc (compared to never) 1-2 times a week 3 times a week 4-7 times a week	 **positive** **positive** **positive**	 **positive**			
Frequency parent teaches songs, poems and nursery rhymes (compared to never) 1-2 times a week 3 times a week 4-6 times a week 7 times a week			 **positive** **positive***		
Frequency child play with friends at home (compared to never) 1-2 times a week 3-7 times a week			 **negative**		
Development problems (compared to none) 1 dev prob 2+ dev prob		**negative**			
Change of pre-school (compared to no change)	**negative**				
Duration of pre-school (centred around mean)	**positive**	**positive**	**positive**	**positive**	**positive**
Duration of reception (centred around mean)	**positive**				
% of children in centre 1sd below GCA mean (centred around mean)	**negative**[#]				
% of children in centre with mothers who have a degree or higher (centred around mean)	**positive**	**positive**	**positive**		**positive**

[#] Just failed to reach statistical significance at 0.05 level

Appendix D

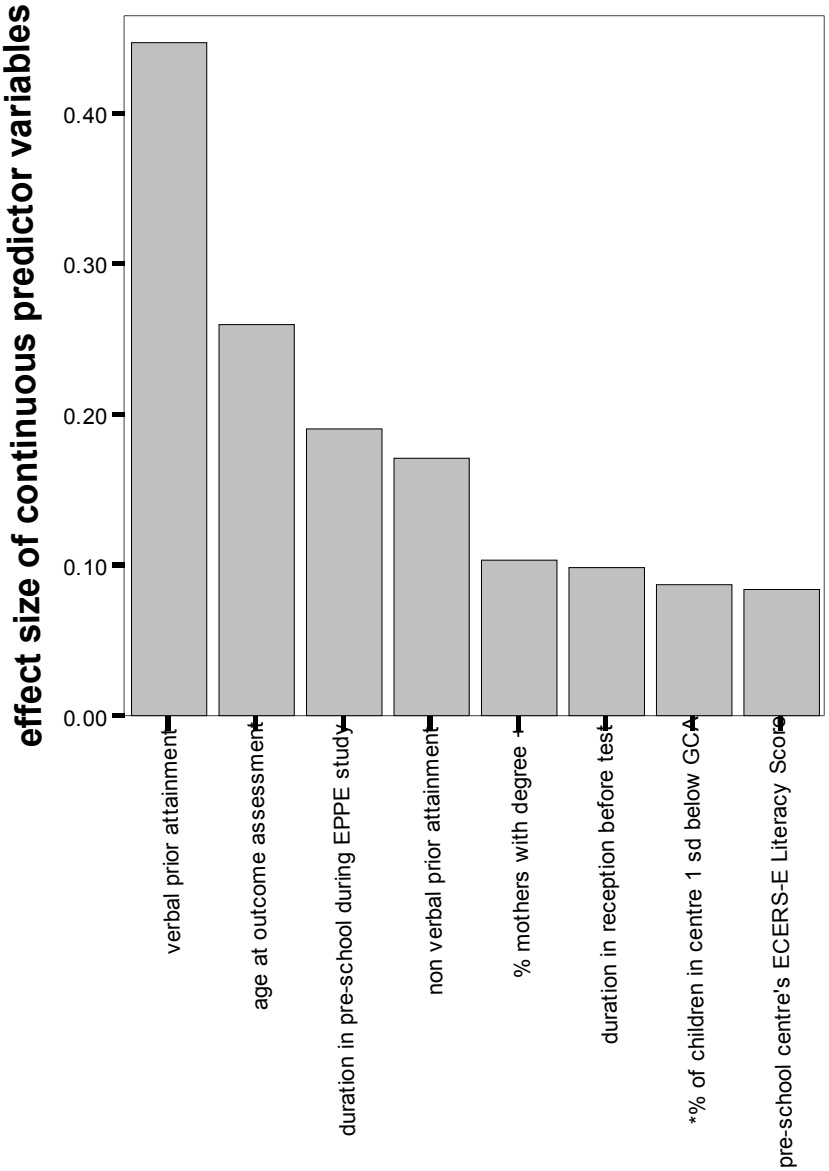
Chart D.1 Pre-reading value added model (with ECERS-E literacy score) - Effect sizes of categorical predictor variables



*denotes a negative effect

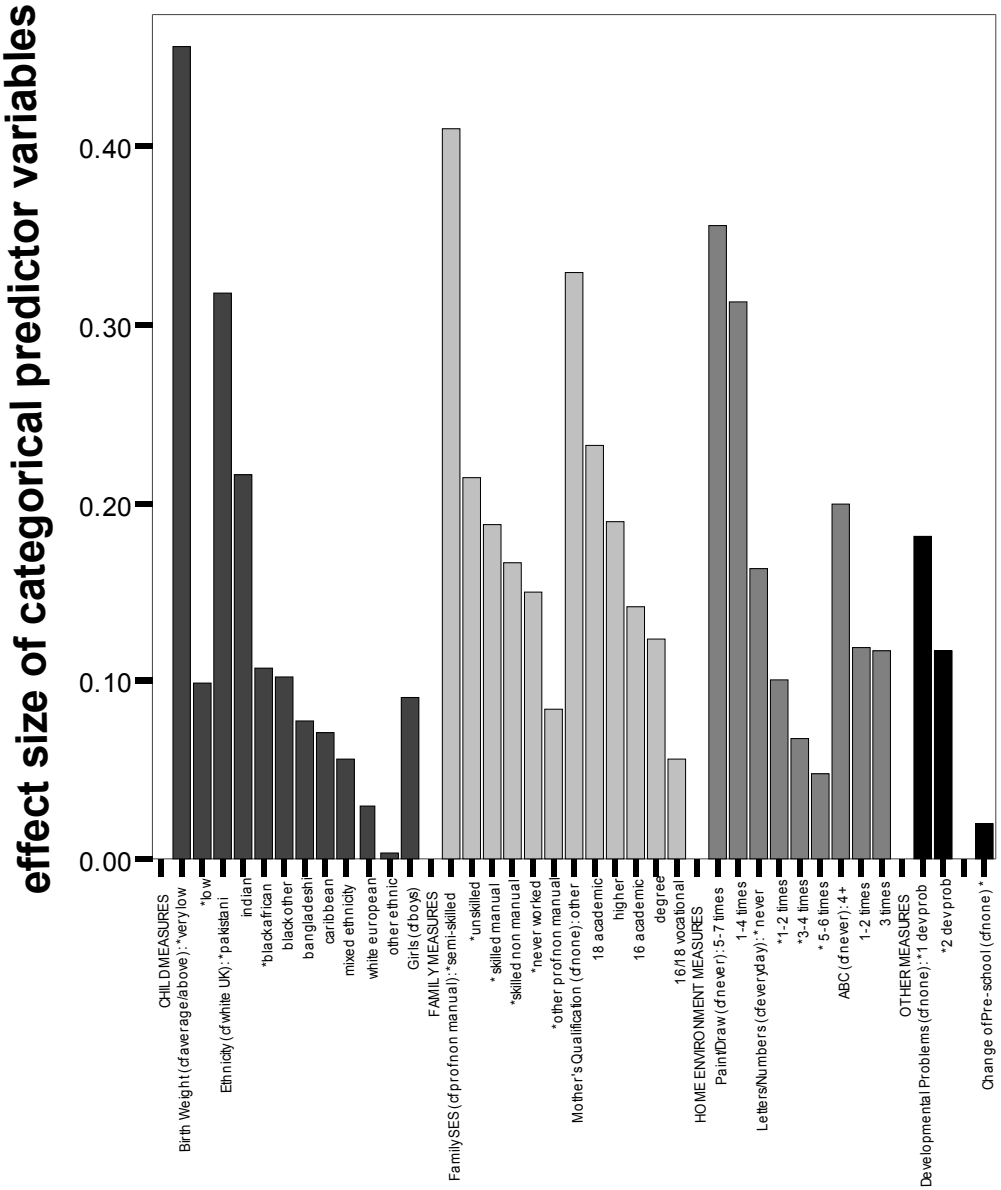
Note that the effect sizes for categorical predictor variables do not take into account the size of groups. Some large effects (e.g. for ethnicity, or mother's qualification other professional) apply to very small numbers of children and not all are statistically significant. Details of the statistical significance of different measures are shown in Table C.1.

Chart D.2 Pre-reading value added model (with ECERS-E literacy score) - Effect sizes of continuous predictor variables



It should be noted that effect sizes for continuous measures may appear modest but apply to all children in the sample, in contrast to those for some categorical predictors which apply to very small sub-groups.

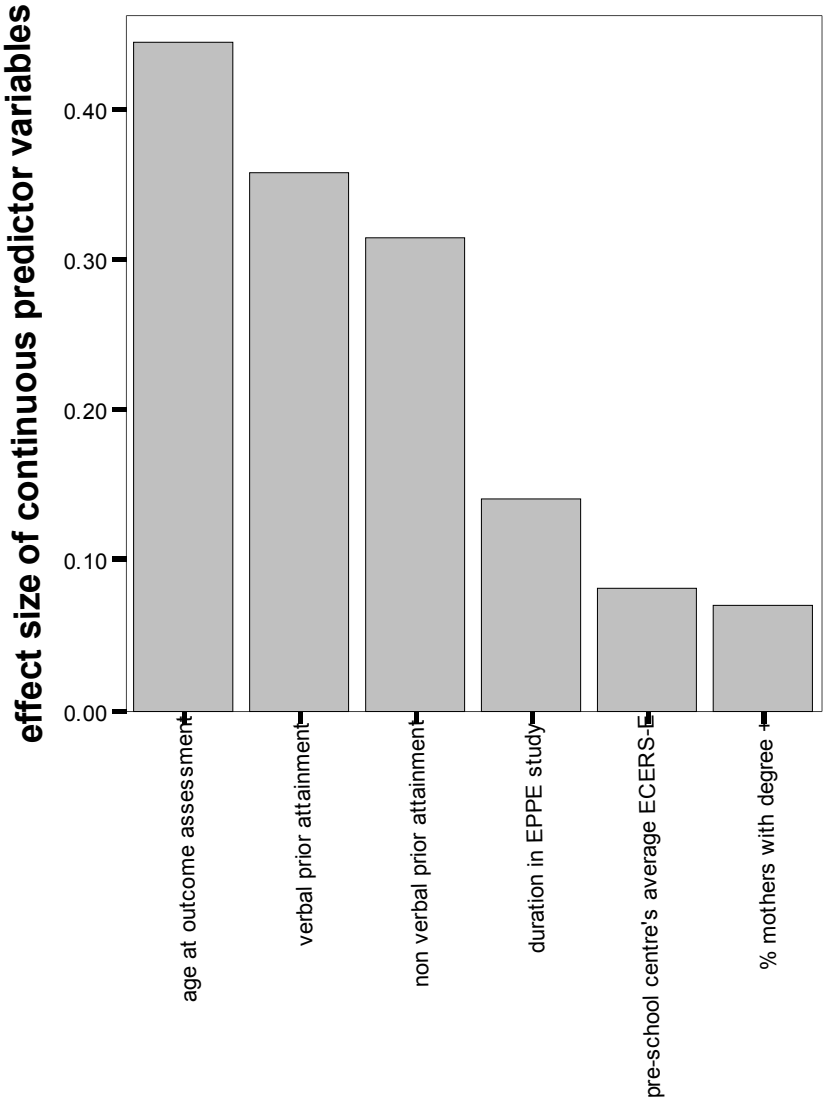
Chart D.3 Early number concepts value added model (with average ECERS-E score) - Effect sizes of categorical predictor variables



*denotes a negative effect

Note that the effect sizes for categorical predictor variables do not take into account the size of groups. Some large effects (e.g. for ethnicity, or mother's qualification other professional) apply to very small numbers of children and not all are statistically significant. Details of the statistical significance of different measures are shown in Table C.2.

Chart D.4 Early number concepts value added model (with average ECERS-E score) - Effect sizes of continuous predictor variables



It should be noted that effect sizes for continuous measures may appear modest but apply to all children in the sample, in contrast to those for some categorical predictors which apply to very small sub-groups.

The Caregiver Interaction Scale and ECERS: comparing separate measures of quality

The table below shows that the two 'quality' rating scales are generally moderately to highly correlated. Note that the Caregiver Interaction Scale assesses the 'relationships' which staff establish with children while the Early Childhood Environment Rating Scales (ECERS-R and ECERS-E) provide a broader profile that includes social interactions, resources, curriculum and facilities.

Table D.1

		Positive relationship	Punitiveness	Permissive	Detachment
ECERS_E	Average total	0.59**	-0.18*	-0.32**	-0.45**
	literacy sub-scale	0.58**	-0.24**	-0.35**	-0.46**
	maths sub-scale	0.47**	-0.14	-0.28**	-0.36**
	science/envir sub-scale	0.45**	-0.05	-0.30**	-0.32**
	diversity sub-scale	0.48**	-0.19*	-0.22**	-0.39**
ECERS_R	Average total	0.58**	-0.23**	-0.33**	-0.49**
	space & furnishings sub-scale	0.31**	-0.15	-0.15	-0.34**
	personal care routines sub-scale	0.29**	-0.02	-0.13	-0.20*
	language and reasoning sub-scale	0.64**	-0.21*	-0.47**	-0.48**
	pre-school activities sub-scale	0.42**	-0.05	-0.25**	-0.26**
	social interaction sub-scale	0.68**	-0.36**	-0.42**	-0.68**
	organisation & routine sub-scale	0.44**	-0.23**	-0.20*	-0.41**
	adults working together sub-scale	0.42**	-0.20*	-0.19*	-0.30**

Appendix E

Chart E.1 Distribution of the number of EPPE children (with pre-school provision and home) in each primary school

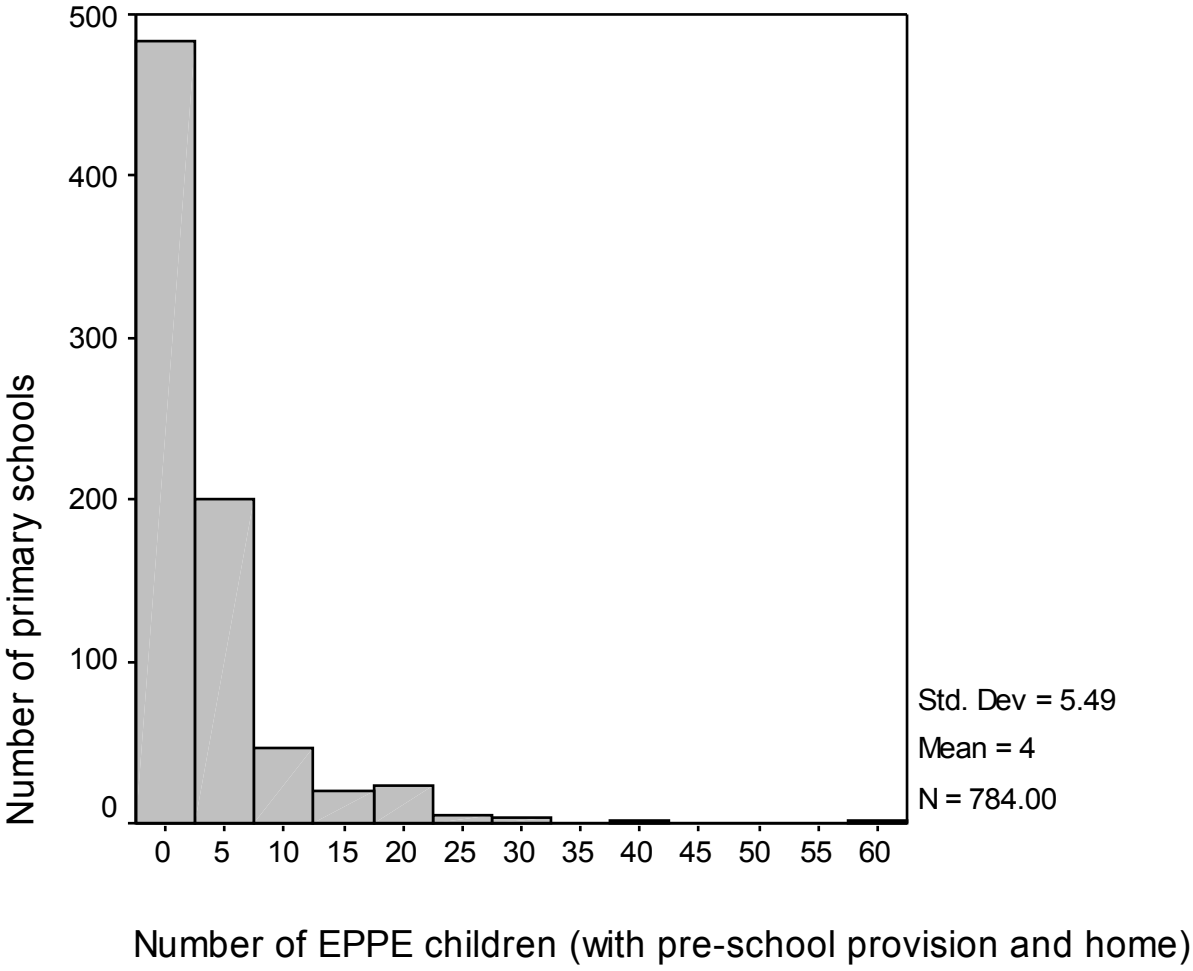


Table E.1 Pre-Reading Contextualised Model with home children
(Impact of child, parent, home environment and other measures on pre-reading attainment at entry to primary school)

		Estimate	SE
Gender (girls compared to boys)		2.404*	0.397
Age at outcome test (centred around mean)		0.727*	0.061
Ethnicity (compared to white UK)	White European	-3.139*	1.080
	Black Caribbean	1.808	1.125
	Black African	4.464*	1.477
	Black other	2.608	1.549
	Pakistani	-2.003	1.315
	Bangladeshi	-1.834	2.737
	other	0.745	1.304
	mixed	0.608	0.838
No. of siblings (compared to none)	1-2	-0.826	0.510
	3+	-3.422*	0.722
Birthweight (compared to average/above average)	very low	-4.55*	1.710
	low	-1.757*	0.793
Free School Meal Eligibility (compared to not eligible)		-1.710*	0.549
Mother's highest level of qualification (compared to no qualifications)			
	vocational	0.066	0.740
	academic age 16	1.017	0.617
	academic age 18	2.392*	0.908
	degree	4.083*	0.939
	higher	5.969*	1.362
	other	7.015*	1.773
Father's highest level of qualification (compared to no qualifications)		0.781	0.807
	vocational	1.010	0.693
	academic age 16	1.218	0.946
	academic age 18	2.235*	0.927
	degree	1.871	1.291
	higher	-1.093	2.007
	other	0.074	0.682
	absent father		
Family SES (compared to professional non-manual)	intermediate non-manual	-2.022*	0.843
	skilled non-manual	-3.317*	0.948
	skilled manual	-3.628*	1.061
	semi-skilled manual	-3.864*	1.101
	unskilled manual	-5.773*	1.621
	never worked	-3.757*	1.623
Frequency parent reads to child (compared to daily)	never / rarely	-0.697	1.210
	weekly	-1.146	1.347
	several times a week	-0.637	0.512
	twice daily	2.180*	0.665
Frequency of library visits (compared to never)	special occasions	-0.062	0.692
	monthly	0.904	0.589
	fortnightly	1.257#	0.676
	weekly	0.920	0.698
Frequency parent teaches letters/numbers (compared to never)			
	1-3 times a week	1.477*	0.585
	4-6 times a week	2.001*	0.676
	daily	3.242*	0.676
Frequency parent teaches abc (compared to never)	1-2 times a week	2.986*	0.654
	3 times a week	5.822*	0.760
	4-7 times a week	6.210*	0.760
Frequency child visits relatives (compared to never)	occasionally	2.840*	1.078
	1-2 times a week	0.886	0.760
	3-4 times a week	0.563	0.847
	5-7 times a week	-0.216	0.920
Developmental problems (compared to none)	1 developmental problem	-2.774*	0.631
	2 + developmental problems	-4.260*	1.878

Number of non-parental carers (compared to only parental carers)		
1 non-parental carer	1.281*	0.482
2 non-parental carers	1.718*	0.595
3 non-parental carers	0.995	0.888
4+ non-parental carers	3.329*	1.171
Duration of pre-school (compared to no pre-school attended) less than a year	1.189	1.027
1–2years	2.641*	0.979
2–3 years	3.723*	1.013
more than 3 years	4.633*	1.135
Duration of reception (centred around mean)	0946*	0.325

*Statistically significant at 0.05 level #Just failed to reach statistical significance at 0.05 level

Table E.2 Early Number Concepts Contextualised Model with home children
(Impact of child, parent, home environment and other measures on early number concepts attainment at entry to primary school)

		Estimate	SE
Gender (girls compared to boys)		0.605*	0.189
Age at outcome test (centred around mean)		0.524*	0.028
Ethnicity (compared to white UK)	White European	-0.780	0.530
	Black Caribbean	0.428	0.511
	Black African	-0.661	0.681
	Indian	0.691	0.761
	Pakistani	-2.105*	0.713
	Bangladeshi	-1.597	1.250
	other	0.395	0.631
	mixed	0.031	0.387
No. of siblings (compared to none)	1-2	-0.103	0.232
	3+	-0.994*	0.326
Birthweight (compared to average/above average)	very low	-2.772*	0.792
	low	-0.858*	0.364
English as an additional language (compared to English as mother tongue)		-1.480*	0.515
Free School Meal Eligibility (compared to not eligible)		-0.752*	0.246
Mother's highest level of qualification (compared to no qualifications)	vocational	0.475	0.335
	academic age 16	0.915*	0.278
	academic age 18	1.502*	0.412
	degree	1.704*	0.409
	higher	2.404*	0.572
	other	1.555	0.811
Family SES (compared to professional non-manual)	Intermediate non-manual	-0.507	0.369
	skilled non-manual	-1.236*	0.404
	skilled manual	-1.602*	0.456
	semi-skilled manual	-2.749*	0.472
	unskilled manual	-2.395*	0.716
	never worked	-0.863	0.724
Frequency parent reads to child (compared to daily)	Never/rarely	-0.861	0.557
	weekly	-1.460*	0.625
	several times a week	-0.103	0.235
	twice daily	0.159	0.308
Frequency of library visits (compared to never)	special occasions	0.394	0.320
	monthly	0.787*	0.272
	fortnightly	0.790*	0.313
	weekly	0.644*	0.322
Frequency parent teaches letters/numbers (compared to never)			
	1-3 times a week	0.544*	0.271
	4-6 times a week	0.378	0.315
	daily	0.760*	0.318
Frequency parent teaches abc (compared to never)	1-2 times a week	0.986*	0.303
	3 times a week	1.440*	0.350
	4-7 times a week	1.785*	0.350
Frequency child paints/draws at home (compared to never)	1-3 times a week	0.882	0.494
	4-6 times a week	1.153*	0.502
	daily	1.127*	0.499
Developmental problems (compared to none)	1 developmental problem	-1.545*	0.290
	2 + developmental problems	-2.028*	0.853
Duration of pre-school (compared to no pre-school attended)	less than a year	1.517*	0.460
	1–2years	2.012*	0.441
	2–3 years	2.502*	0.458
	more than 3 years	2.467*	0.516
Duration of reception (centred around mean)		-0.052	0.148

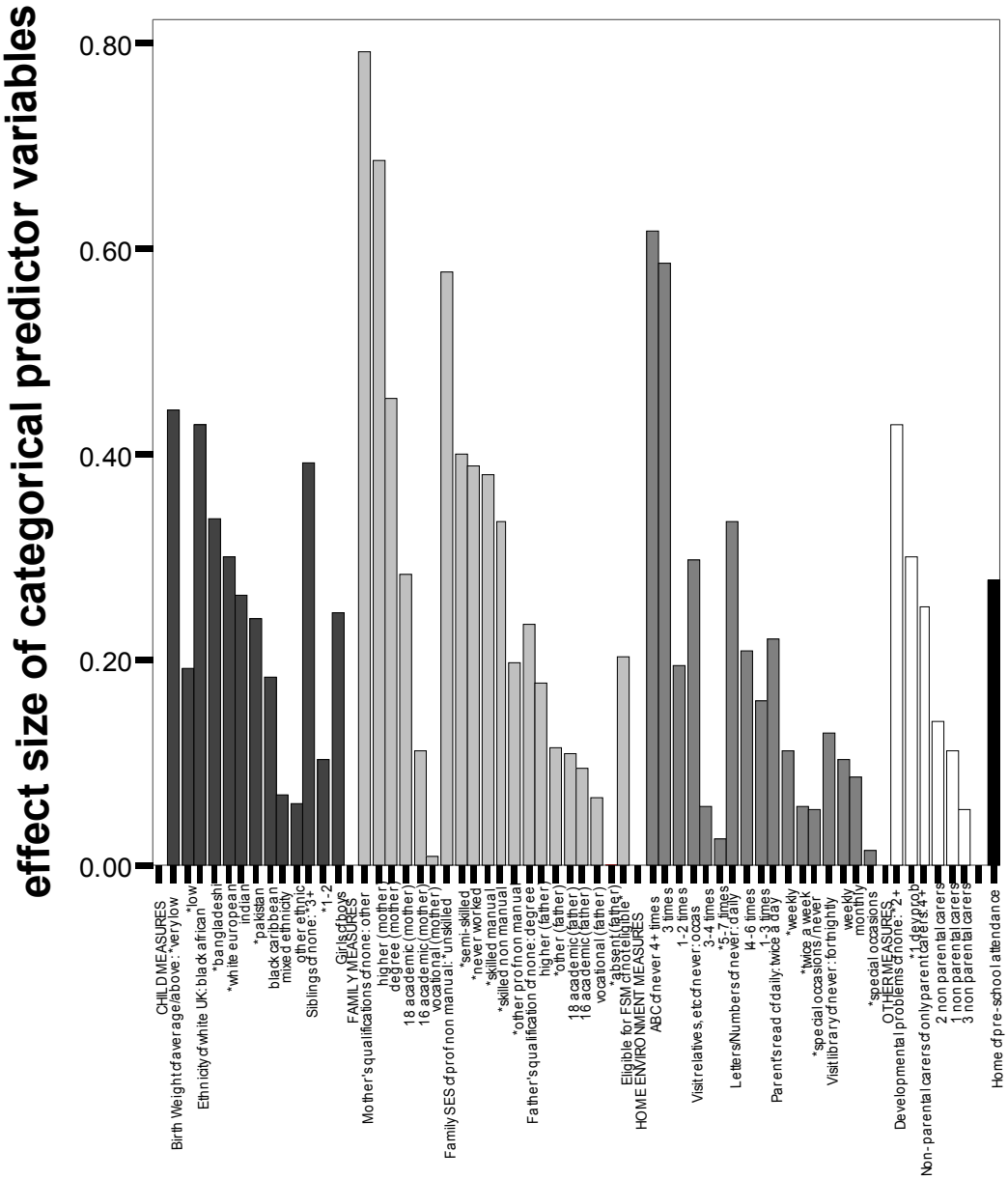
*Statistically significant at 0.05 level # Just failed to reach statistical significance at 0.05 level

Table E.3 Language Contextualised Model with home children
(Impact of child, parent, home environment and other measures on number attainment at entry to primary school)

		Estimate	SE
Age at outcome test (centred around mean)		0.443*	0.032
Ethnicity (compared to white UK)	White European	-1.931*	0.662
	Black Caribbean	-2.471*	0.634
	Black other	-2.330*	0.848
	Indian	-1.288	0.945
	Pakistani	-4.838*	0.881
	Bangladeshi	-4.725*	1.554
	other	-1.930*	0.783
	mixed	-1.399*	0.483
No. of siblings (compared to none)	1-2	-0.306	0.289
	3+	-1.538*	0.409
Birthweight (compared to average/above average)	very low	-2.886*	0.979
	low	-0.594	0.458
English as an additional language (compared to English as mother tongue)		-5.817*	0.643
Free School Meal Eligibility (compared to not eligible)		-0.833*	0.308
Mother's highest level of qualification (compared to no qualifications)	vocational	0.151	0.419
	academic age 16	0.837*	0.347
	academic age 18	1.804*	0.514
	degree	3.479*	0.511
	higher	3.969*	0.715
	other	0.741	1.000
Family SES (compared to professional non-manual)	intermediate non-manual	-0.620	0.462
	skilled non-manual	-1.608*	0.505
	skilled manual	-2.260*	0.571
	semi-skilled manual	-2.793*	0.591
	unskilled manual	-3.135*	0.895
	never worked	-3.508*	0.895
Frequency parent reads to child (compared to daily)	never/rarely	-1.476*	0.694
	weekly	-1.855*	0.781
	several times a week	-0.636*	0.294
	twice daily	0.683	0.384
Frequency of library visits (compared to never)	special occasions	0.282	0.399
	monthly	0.879*	0.339
	fortnightly	1.643*	0.391
	weekly	1.062*	0.402
Frequency parent teaches abc (compared to never)	1-2 times a week	1.102*	0.376
	3 times a week	1.741*	0.439
	4-7 times a week	1.855*	0.442
Frequency parent teaches songs, poems and nursery rhymes (compared to never)	1-2 times a week	0.513	0.470
	3-5 times a week	1.830*	0.449
	6 times a week	1.990*	0.482
	7+ times a week	1.803*	0.481
Frequency child play with friends at home (compared to never)	occasional	0.913	0.697
	1-2 times a week	0.732*	0.274
	3-4 times a week	-1.096*	0.376
	5-7 times a week	-0.341	0.387
Developmental problems (compared to none)	1 developmental problem	-1.789*	0.360
	2 + developmental problems	-2.819*	1.068
Number of non-parental carers (compared to only parental carers)	1 non-parental carer	0.538#	0.278
	2 non-parental carers	0.595	0.342
	3 non-parental carers	1.476*	0.513
	4+ non-parental carers	0.209	0.678
Duration of pre-school (compared to no pre-school attended)	less than a year	2.689*	0.611
	1–2 years	2.234*	0.544
	2–3 years	2.552*	0.568
	more than 3 years	3.630*	0.631
Duration of reception (centred around mean)		-0.249	0.168

*Statistically significant at 0.05 level #Just failed to reach statistical significance at 0.05 level

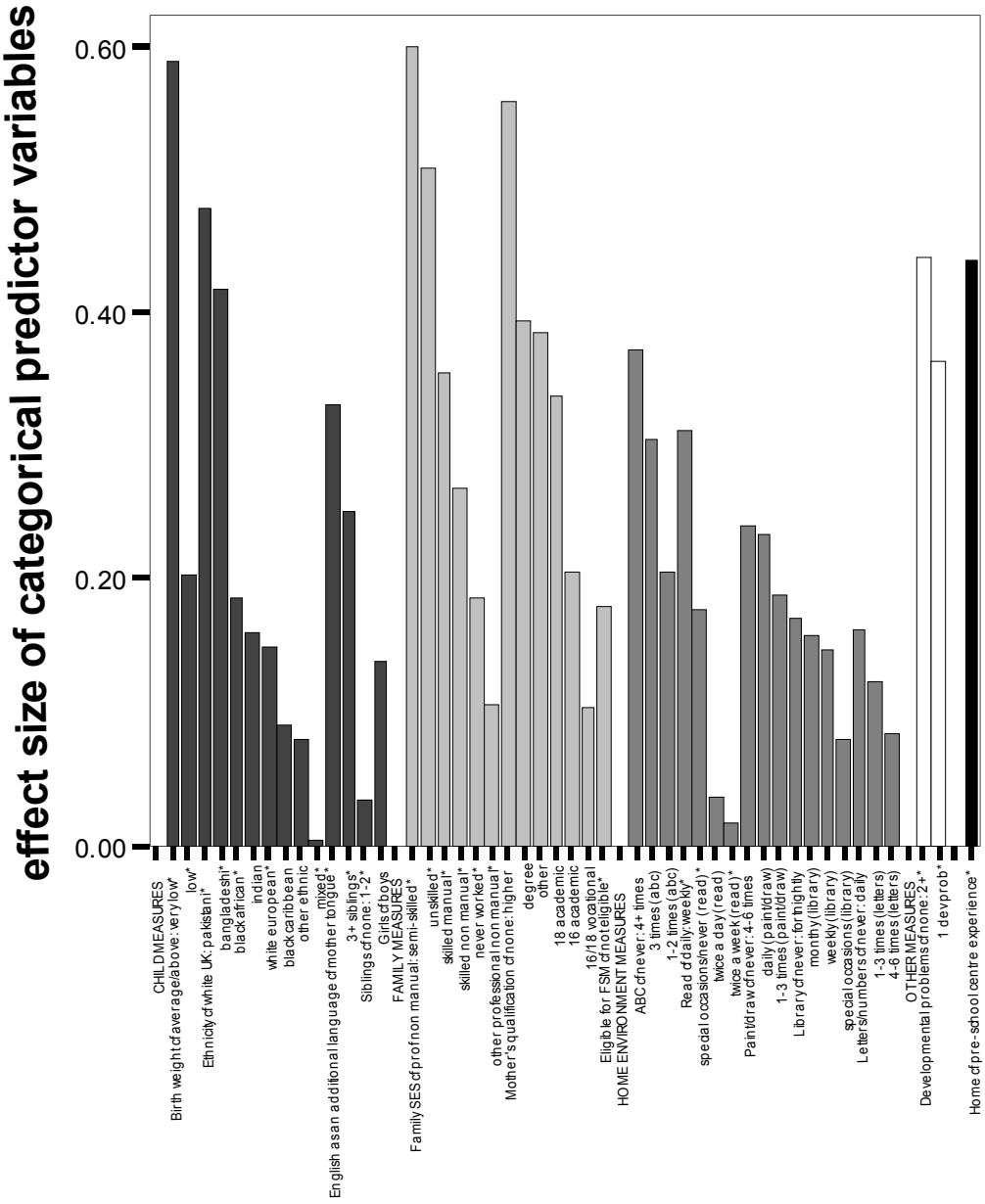
Chart E.2 Pre-reading contextualised model (home children vs children who attended a pre-school centre) at entry to primary school - Effect sizes of categorical predictor variables



* denotes a negative effect

Note that the effect sizes for categorical predictor variables do not take into account the size of groups. Some large effects (e.g. for ethnicity, or mother's qualification other professional) apply to very small numbers of children and not all are statistically significant. Details of the statistical significance of different measures are shown in Table E.1.

Chart E.3 Early number concepts contextualised model (home children vs children who attended a pre-school centre) at entry to primary school - Effect sizes of categorical predictor variables



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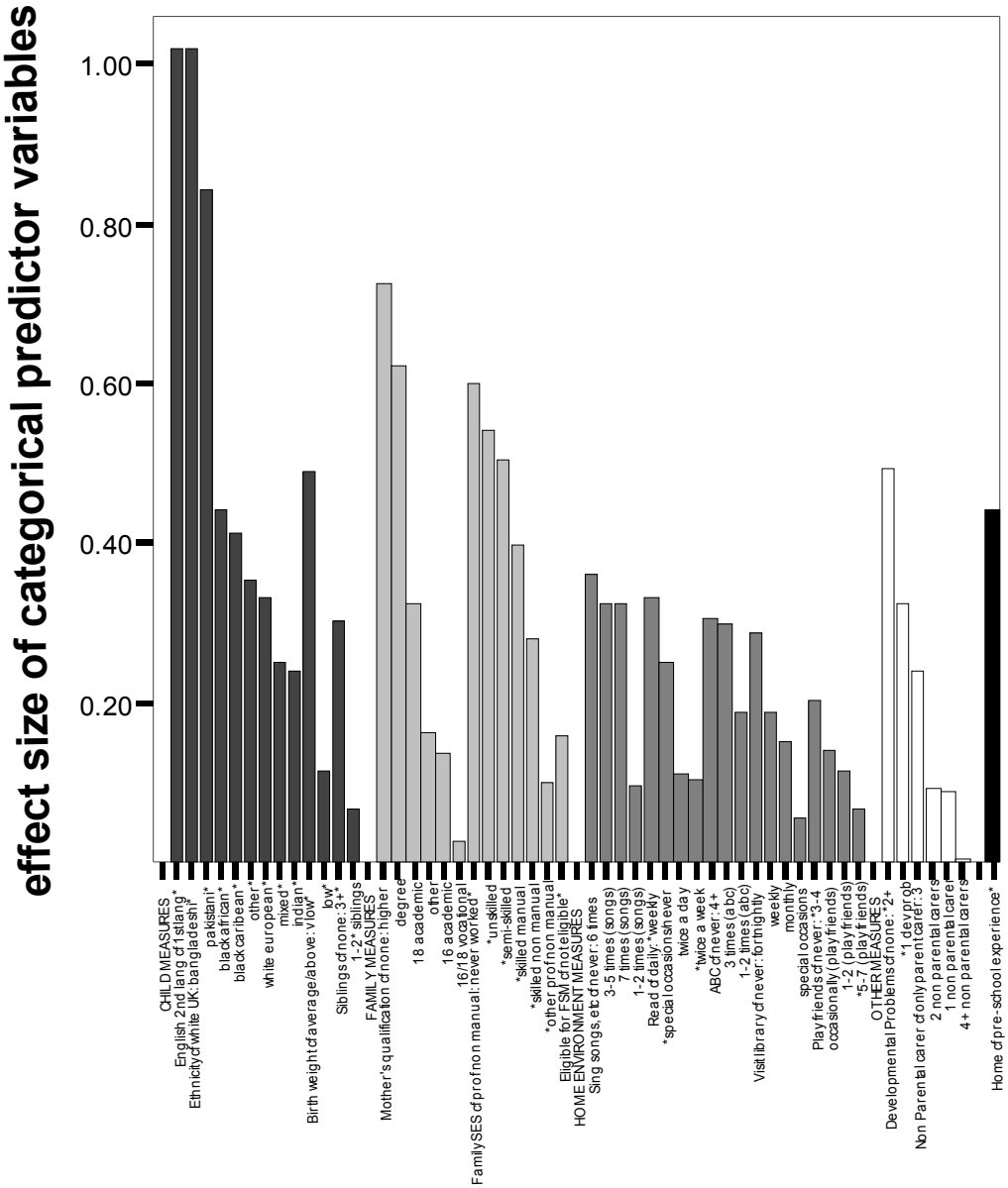
Note that the effect sizes for categorical predictor variables do not take into account the size of groups. Some large effects (e.g. for ethnicity, or mother's qualification other professional) apply to very small numbers of children and not all are statistically significant. Details of the statistical significance of different measures are shown in Table E.2.

Chart E.4 Language contextualised model (home children vs children who attended a pre-school centre) at entry to primary school - Effect sizes of categorical predictor variables



*denotes a negative effect

Note that the effect sizes for categorical predictor variables do not take into account the size of groups. Some large effects (e.g. for ethnicity, or mother's qualification other professional) apply to very small numbers of children and not all are statistically significant. Details of the statistical significance of different measures are shown in Table E.3.

Appendix F

Findings from EYTSEN study

Further analyses were conducted to investigate the impact of 'multiple disadvantage' as part of the EYTSEN Project (which focuses on the identification of children 'at risk' of SEN). An index was created based on 10 indicators in total: three child variables, six parent variables, and one related to the home learning environment. All the variables were chosen because they related to low baseline attainment when looked at in isolation (as described above). Where indicators were closely related, such as first language and ethnicity, only the most significant was included.

Table F.1 Multiple disadvantage indicators

Child variables	Disadvantage indicator
• First language • Large family • Pre-maturity/ low birth weight	English not first language 3 or more siblings Premature at birth or below 2500 grams
Parent variables	
• Mother's highest qualification level • Social class of Father's occupation • Father's employment status • Young mother • Lone parent • Mother's employment status	No qualifications Semi-skilled, unskilled, never worked, absent father Not employed Age 13—17 at birth of EPPE/EPPE-E child Single parent Unemployed
Home environment variables	
• Home environment scale	Bottom quartile

In the sample, 23.5% of children experienced none of the indicators of disadvantage selected. This group was much less likely to be identified as at strong cognitive risk at entry to primary school (only 8.4% of children in this group experienced none of the disadvantage factors). By contrast, those experiencing 5 or more factors (only 5.5% of all children in the EPPE sample) formed 16.6% of those identified as at strong cognitive risk at entry to primary school, this is three times higher than expected. These data confirm that multiple disadvantage remains an important risk indicator for low cognitive attainment during the early years.

Table F.2 Multiple disadvantage and percentage pupils identified as 'at risk' in cognitive assessments at entry to primary school

Number of factors	**All children n %**	**Cognitive risk (GCA 1 sd below national mean)**	**Strong cognitive risk (GCA 1 sd below sample mean)**	**'at risk' Pre reading**	**'at risk' Early number concepts**
Mean MD score	1.71(sd=1.49)	2.65 (sd=1.63)	2.82 (sd=1.66)	2.46 (sd=1.56)	2.62 (sd=1.67)
0 1-2 3-4 5+	637 23.5 1345 49.6 575 21.3 151 5.5	9.0 30.8 36.2 14.0	8.4 37.6 37.4 16.6	9.2 46.3 33.8 10.7	11.1 38.2 36.5 14.3

Of the children experiencing five or more multiple disadvantage factors over 54 per cent were at strong cognitive risk in terms for general cognitive ability (i.e. 1 sd below sample mean GCA).

Glossary of terms

Age standardised scores Assessment scores that have been adjusted to take account of the child's age at testing. This enables a comparison to be made between the performance of an individual pupil, and the relative achievement of a representative sample of children in the same age group throughout the country or, in this case, the relative achievement of the EPPE sample.

ASBI The Adaptive Social Behaviour Inventory (ASBI) (Hogan et al, 1992) is a rating scale consisting of 30 items completed by a caregiver of a child. The items can be combined to produce factors that are measures of different aspects of the child's social behaviour. For further details, see EPPE Technical Paper 8b.

'at risk' The ETYSEN report acknowledges that the term 'at risk' is a complex one which will differ depending on the particular criteria used. In the ETYSEN study cognitive risk is defined as 1 sd below national average and strong cognitive risk as1 sd below sample average. These provide definitions of children who may be seen to be 'at risk' on the basis of their cognitive attainment at entry to pre-school.

Attendance The number of sessions attended at the target centre by an EPPE child from entry to study (BAS assessment) to leaving the target pre-school (based on pre-school centre registers). This measure provides a crude indicator of amount of target pre-school experience.

Baseline measures Assessments taken by the EPPE child at entry to the study. These assessment scores are subsequently employed as prior attainment measures in a value added analysis of pupils' cognitive progress.

Birthweight Babies born weighing 2500 grams (5lbs 8oz) or less are defined as below normal birthweight, fetal infant classification is below 1000 grams, very low birthweight is classified as 1001-1005 grams and low birthweight is classified as 1501-2500 grams (Scott and Caren, 1989).

British Ability Scales (BAS) This is a battery of assessments specially developed by NFER-Nelson to assess very young children's abilities. The assessments used at entry to the EPPE study and entry to reception were:
Block building - Visual-perceptual matching, especially in spatial orientation (only entry to EPPE 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 children without English
Verbal comprehension – Receptive language, understanding of oral instructions involving basic language concepts.

Caregiver Interaction Scale (CIS) A rating scale consisting of 26 items completed by an observer of the interactions between caregivers and children. The items are grouped to produce 4 sub-scales: positive relationships, punitiveness, permissiveness and detachment. The CIS was developed by Arnett (1989).
- Positive relationships are a sub-scale made up of 10 items indicating warmth and enthusiasm interaction with children by the caregiver.
- Punitiveness is a sub-scale made up of 8 items indicating harsh or over-controlling behaviour in interaction with children by the caregiver.
- Permissiveness is a sub-scale made up of 4 items indicating avoidance of discipline and control of children by the caregiver.

- Detachment is a sub-scale made up of 4 items indicating lack of involvement in interaction with children by the caregiver.

Centre level variance The proportion of variance in a particular child outcome measure (e.g. pre-reading scores at start of primary school) attributable to differences between individual centres rather than differences between individual children.

***Child background* factors** Child background characteristics such as age, gender, ethnicity.

Compositional effects The impact of peer group measures on a child's individual outcomes. For example, when the characteristics of children in a centre (measured as a centre level aggregated variable) show a significant relationship with outcomes at the individual child level, after controlling for the same variable at the individual level. For further details see Harker (2001).

***Confidence intervals at the 95%* level** A range of values which can be expected to include the 'true' value in 95 out of 100 samples (i.e. if the calculation was repeated using 100 random samples).

Contextualised models Cross-sectional multilevel models exploring children's cognitive attainment at entry to primary school, controlling for child, parent 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.

CSBQ The Child Social Behaviour Questionnaire (CSBQ) is an extension of the ASBI and has 45 items concerning a child's social behaviour rated by caregivers. The items can be combined produce factors that are measures of different aspects of the child's' social behaviour. For further details see EPPE Technical Paper 8b

Duration In terms of the value added models, the duration of pre-school covers the time period between date of BAS assessment at entry to the EPPE study until entry to primary school. Note that the number of months of pre-school attended before the child entered the EPPE study is not included in this duration measure. A separate 'duration' measure of amount of time in pre-school prior to entering the study was tested but was not found to be significant (note that this 'duration' measure is confounded with prior attainment). In the contextualised models, duration of pre-school refers to the time period between entry to the target pre-school until entry to primary school. These duration measures provide a crude indication of length of pre-school experience.

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, 1999) 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), and more importantly the Curriculum Guidance for the Foundation Stage which at the time was in trial stage.

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.

Family factors Examples of family factors are mother's qualifications, father's employment and family SES.

General Cognitive Ability (GCA) A measure of children's overall cognitive ability, incorporating non-verbal and verbal BAS sub-scales.

Hierarchical nature of the data Data that clusters into pre-defined sub-groups or levels within a system (e.g. young children, pre-school centres, LEAs).

Home learning environment factors Measures derived from reports from parents (at interview) about what children do at home, for example, playing with numbers and letters, singing songs and nursery rhymes.

Intervention study A study in which researchers 'intervene' in the sample to control variables i.e. control by setting, the adult:child ratios in order to compare different specific ratios in different settings. EPPE is not an intervention study in that it investigates naturally occurring variation in pre-school settings.

Intra-centre correlation The intra-centre correlation measures the extent to which the scores of children in the same centre resemble each other as compared with those from children at different centres. The intra-centre correlation provides an indication of the extent to which unexplained variance in children's progress (i.e. that not accounted for by prior attainment) may be attributed to differences between pre-school settings. This gives an indication of possible variation in pre-school effectiveness.

Language attainment Composite formed by adding together the scores for two of the BAS assessments (naming vocabulary and verbal comprehension).

Level 5 Qualification Level used in the EPPE analyses which indicates qualified teacher status (QTS), a pre-school worker who has undergone a course of study leading to an award which enables them to practice as a qualified teacher.

Multiple Disadvantage Based on three child variables, six parent variables, and one related to the home learning environment which were considered 'risk' indicators when looked at in isolation. A child's 'multiple disadvantage' was calculated by summing the number of indicators the child was at risk on.

Multilevel modelling A methodology that allows data to be examined simultaneously at different levels within a system (e.g. young children, pre-school centres, LEAs), essentially a generalisation of multiple regression.

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.

Net effect The unique contribution of a particular variable upon an outcome while other variables are controlled.

Outliers Pre-school centres where children made significantly greater/less progress than predicted on the basis of prior attainment and other significant child, parent and home learning environment characteristics.

Pedagogical strategies Strategies used by the educator to support learning. These include the face interactions with children, the organisation of the resources and the assessment practices and procedures.

Pre-reading attainment Composite formed by adding together the scores for phonological awareness (rhyme and alliteration) and letter recognition.

Prior attainment factors Measures which describe pupils' achievement at the beginning of the phase or period under investigation (e.g. taken on entry to primary or secondary school or, in this case, on entry to the EPPE study).

Quality Measures of pre-school centre quality collected through observational assessments (ECERS-R, ECERS-E and CIS) made by trained researchers.

Sampling profile/procedures The EPPE sample was constructed by:

- Five regions (six LEAs) randomly selected around the country, but being representative of urban, rural, inner city areas.
- Pre-schools from each of the 6 types of target provision (nursery classes, nursery schools, local authority day care, private day nurseries, play groups and integrated centres) randomly selected across the region.

Significance level Criteria for judging whether differences in scores between groups of children or centres 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 child's ability to 'socialise' with other adults and children and their general behaviour to others.

Socio Economic Status (SES) Occupational information was collected by means of a parental interview when children were recruited to the study. 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 percent of cases fall within one standard deviation of the mean and 95 percent of cases fall within two standard deviations.

Target centre A total of 141 pre-school centres were recruited to the EPPE research covering 6 types of provision. The sample of children were drawn from these target centres.

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 children's cognitive progress over the pre-school period, controlling for prior attainment and significant child, parent and home learning environment characteristics.

Value added residuals Differences between predicted and actual results for pre-school centres (where predicted results are calculated using value added models).

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