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The impact of pre-school on young children's cognitive attainments at entry to reception

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This article explores the impact of pre-school experience on young children's cognitive attainments at entry to primary school and analyses data collected as part of a wider longitudinal study, the Effective Provision of Pre-school Education (EPPE) project, which followed a large sample of young children attending 141 pre-school centres drawn from six types of provider in five English regions. The article compares the characteristics and attainments of the pre-school sample with those of an additional 'home' sample (children who had not attended pre-school) recruited at entry to reception. Multilevel analyses of relationships between child, parent and home environment characteristics and children's attainments in pre-reading, early number concepts and language skills are presented. Duration of time in pre-school is found to have a significant and positive impact on attainment over and above important influences such as family socio-economic status, income, mother's qualification level, ethnic and language background. The research also points to the separate and significant influence of the home learning environment. It is concluded that pre-school can play an important part in combating social exclusion by offering disadvantaged children, in particular, a better start to primary school.

Introduction

Previous research, mainly conducted in the USA, has drawn attention to the benefits of high quality early childhood intervention programmes in preparing highly disadvantaged children for school (Slavin *et al.*, 1994). Longitudinal follow-ups indicate social and economic benefits 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

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education and care has been conducted in the UK. The *Start Right* enquiry (Ball, 1994) reported that small-scale studies suggest a positive impact for pre-schools but identified a need for larger, longitudinal studies of the impact of pre-school education and care.

McCartney and Jordan (1990) made a comparison of childcare effects and school effects research (SER) in the USA. They argued that the study of childcare effects and SER has 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?

They concluded that the strong parallels between childcare and SER should encourage researchers in the two fields to monitor developments in both. In this way, each would benefit from the conceptual and methodological advances made by the other.

In the UK there has been a long tradition of variation in the provision for, and access to, pre-school places and 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, centres that combine education and care). Regional variations in provision reflect differences in local authority (LA) priorities, funding and geographical conditions (e.g. rural/urban, level of socio-economic disadvantage).

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 provision are most 'effective' in promoting young children's progress and development, and to explore whether pre-school experience continues to influence children after they start primary school during Key Stage 1 (KS1). EPPE is the first longitudinal pre-school research in Europe to use an educational effectiveness design based on sampling children in a range of different pre-school settings.

The study explores the impact of a wide variety of child, parent and family factors, including aspects of the home learning environment, on child outcomes. It investigates whether different types of pre-school provision differ in their impact, and seeks to identify any variations between individual pre-school centres, in children's cognitive progress and social behavioural development. EPPE also investigates the impact of pre-school processes and pedagogy, including quality and duration of pre-school experience. The research design adopts a mixed methods approach, including detailed statistical analyses of effectiveness and in-depth case studies of individual pre-school centres.

This article focuses on three research questions.

1. What is the variation in children's school entry assessments for different groups of children?
2. What is the impact of amount and duration of pre-school experience?

Table 1. Numbers of children in the pre-school sample by type of provider

Type of provider	Centres	Pre–school sample children			
	n	Total *n* of children by type	Mean *n* of children in a centre	SD	Range
Nursery class	25	588	23.5	3.1	13–28
Playgroup	34	609	17.9	4.7	10–28
Private day nursery	31	516	16.7	5.1	6–27
Local authority day care	24	433	18.0	5.0	10–28
Nursery school	20	519	26.0	2.4	19–30
Integrated centre	7	192	27.4	3.6	25–35
All	141	2857	20.3	5.7	6–35

3. How do children entering school without any pre-school experience (home children) differ from their peers who have attended centres in the main EPPE pre-school sample?

Methods

Multilevel analyses (Goldstein, 1995) are central to the quantitative study of child progress and social behavioural development and the impact of different pre-school centres. 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 variation between centres. Multilevel models also 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.

Background information about child, parent and family characteristics was obtained through parent interviews. Most interviews were face to face with children's mothers and usually took place at the child's pre-school centre, but for some parents telephone interviews were more convenient. All parents agreed to their child taking part in the EPPE study and gave written consent. A 97% response rate was achieved, although in some instances particular questions had a slightly lower rate (e.g. occupations). Interviews were generally conducted within 10 weeks of recruiting a child to the study. Home children were identified at primary school entry.

Characteristics of the pre-school sample

The sample was drawn from six English LAs in five regions, 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 (see

Table 2. Cognitive assessments at entry to primary school

Name of assessment	Assessment content
British Ability Scales Second Edition (BASII) (Elliot *et al.*, 1996):	Cognitive development
• Verbal comprehension	• Verbal skills
• Picture similarities	• Non-verbal reasoning skills
• Naming vocabulary	• Verbal skills
• Pattern construction	• Spatial awareness/reasoning
• Early number concepts	• Reasoning ability
Letter recognition	Lower case letters
Phonological awareness (Bryant & Bradley, 1985)	Rhyme and alliteration Letter recognition

Table 3. Correlations between primary school entry assessments

	Pre-reading	Early number concepts	Language	Non-verbal reasoning	Spatial awareness/ reasoning
Pre-reading	1.00	0.60	0.55	0.42	0.45
Early number concept		1.00	0.59	0.51	0.53
Language			1.00	0.50	0.41
Non-verbal reasoning				1.00	0.42

All correlations are significant at the 0.01 level.

Table 1). 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 six 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.[1]

Children were assessed at entry to the pre-school study (age three years plus) and again at entry to primary school (see Table 2) (Sylva *et al.*, 1999). This article focuses on attainment at primary school entry. Assessments were chosen to be compatible with the Desirable Outcomes for Pre-School Education, later replaced by Early Learning Goals and guidance for the Foundation Stage (Department for Education and Employment [DfEE]/Qualifications and Curriculum Authority [QCA], 2000). Measures of children's social behavioural development were also collected and are reported elsewhere (Sammons *et al.*, 2003).

Children not fluent in English were assessed on two non-verbal BAS II scales (Picture Similarity and Pattern Construction) and BAS II Copying, a measure of spatial ability, (Elliot *et al.*, 1996).

Table 4. Characteristics of home and main pre-school sample

	Children with pre-school experience		Home children	
	n	%	*n*	%
*Not known/excluded.				
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
Three 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

The two verbal BAS II scales (Verbal Comprehension and Naming Vocabulary) provide a measure of language. A pre-reading composite was formed from phonological awareness (rhyme and alliteration) and letter recognition.

Table 3 shows the correlations between children's scores on the different assessments. The strongest association is between pre-reading and early number concepts whilst the weakest correlation is between language and spatial awareness/ reasoning.

Characteristics of the home and EPPE pre-school sample

The main pre-school child sample with matched data (in other words, data at both assessment time points, i.e. entry to the pre-school study and entry to primary school) is 2857, representing around 95% of the total sample at entry to the study. An additional group of over 300 'home' children was recruited at entry to primary school. Table 4 illustrates some of the differences in the characteristics of home children and

Table 5. Comparisons of average attainment between home children and those with 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

the main pre-school sample. Home children were more likely to be from ethnic minority groups, a higher proportion had English as an additional language (EAL), were from large families and had mothers with no formal qualifications than in the main pre-school sample. Also, more of the home group had mothers who were not working, and more were receiving free school meals (FSM).

Figures in Table 5 reveal that home children's mean attainment scores are markedly lower than those of children who had attended pre-school.

The impact of child background characteristics

At entry to the EPPE pre-school study (age three years plus) over a third of the main pre-school sample showed low attainment, one standard deviation or more below the national mean for the BAS measure of General Cognitive Ability (GCA)—the expected proportion would be around 17%. By entry to primary school, however, the proportion of low scoring children in the pre-school sample had fallen to around a fifth (21%). For the home group a much higher proportion had low GCA scores at primary school entry (nearly 52%) and their teachers reported proportionally more home than pre-school children as having a special educational need (SEN) during KS1 (Sammons *et al.*, 2004). However, without further analysis, it cannot be concluded that these lower scores are a result of lack of pre-school experience due to the generally more disadvantaged characteristics of the home child sample that also have an important influence on attainment. Further multilevel analyses were therefore conducted to explore differences in attainment related to child, family and home background influences in more detail.

Multilevel models are a generalized form of regression analysis, particularly suited to the study of educational and social data exhibiting a hierarchical structure, and provide a method of exploring the extent of variation in children's cognitive attainments and progress (Goldstein, 1995). They were used to investigate the impact of different background measures on young children's attainment at entry to primary school. In this way the impact of, for example, number of siblings or premature birth on attainment patterns can be established *net* of the influence of other factors. The

results provide estimates of statistical significance and can be analysed to compare the size of effects for specific background characteristics. The models identify the set of measures that, taken together, provide the best statistical explanation of differences in children's attainment. They provide important evidence concerning the strength of background influences on cognitive development at the start of primary school. Tables in Appendix 1 summarize the results, showing the size of differences in raw score points, and the statistical significance of differences.

The main findings in relation to language, pre-reading and early number concepts are described for each group of measures—child, family and home environment.

Child measures

Gender differences in favour of girls were identified for pre-reading and early number, but were not significant for language attainment. Age in months at reception assessment was highly significant for all outcomes, as might be expected, with older children showing higher attainments, reflecting the importance of age in developmental terms for young children.

Low birth weight children had significantly lower pre-reading 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. Birth weight effects were strongest for early number attainment.

Children from larger families (with three or more siblings) also showed significantly lower scores for pre-reading, early number concepts and language; the impact was strongest for pre-reading attainment.

EAL children 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 attained lower scores in early number concepts 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. It should be noted that, as with other predictors in the models, the ethnic differences reported are *net* of the influences of all other factors tested, including family socio-economic status (SES) and mother's qualification, for which there are also significant differences between ethnic groups.

These results indicate that the choice of different assessments to measure children's attainment at primary school entry may have equity implications. Ethnic differences

are more likely to be identified in language than in early number concept or pre-reading skills. While the present findings are based on the particular set of assessments used in the EPPE research, this issue is likely to apply to reception baseline schemes in general (Sammons & Smees, 1998).

Family measures

FSM, an indicator of low income and socio-economic disadvantage, showed a negative relationship with attainment. Though statistically significant, this impact was moderate (smaller than the gender difference for pre-reading, for example).

Mother's highest educational qualification showed a positive, strong and significant impact across all cognitive outcomes. 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 group of children 'mother with degree or higher degree' is compared with the group 'mother no qualifications'. The equivalent qualification variable for fathers was only significant for pre-reading.

When tested individually, a significant positive relationship for 'mother working full-time' was found in comparison with the group 'mother not working'. However, mother's employment status was no longer significant when other parent variables (including mother's highest qualification) are added to the model. From the data we can conclude that there is no evidence that children whose mothers worked either part- or full-time have significantly lower cognitive attainments at the start of primary school. Fathers' employment status was not significant for pre-reading, early number or language attainment.

Findings on family SES, based on parents' highest social class of occupation, indicate that, overall, non-manual professional and other managerial (classes 1 and 11) status is associated with significantly higher attainment levels over and above other influences.

Home environment measures

The frequency with which parents said their 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. Such alphabet 'teaching' would often be informal, through drawing attention to letters in a range of different contexts (e.g. books, advertisements, magazines, food labels). For pre-reading this difference is larger in terms of raw points than the gap for mother's highest qualifications, pointing to the important and independent influence of this measure.

Library visits also show a smaller but significant positive impact on pre-reading, early number and language attainment. The frequency with which parents reported they taught their child songs or nursery rhymes also showed a significant positive impact on language scores. Playing with letters/numbers is significant for pre-reading

and early numbers concepts. Additionally, the frequency with which the child paints and draws shows a positive relationship with early numbers concepts.

The frequency with which parents reported reading to the child is associated with higher scores for pre-reading, language and early number. Higher frequencies (daily or twice daily) showed the most positive impact compared with the group who said they never or rarely read to their child.

Details about the number of non-parental carers a child had experienced before entering the study (e.g. relatives, usually grandmothers, or childminders) was collected. This showed a positive relationship for attainment in both pre-reading and language (the group of children with non-parent carers obtaining higher scores than children with no non-parental carers, taking account of the impact of other factors). This suggests that additional stimulation from a range of adults may have some cognitive benefits for young children.

By contrast, children whose parents reported that their children often played with friends at home (three or more times a week) showed lower scores in language than those who reported that their never played with friends at home. Children reported to play with friends at home once or twice a week, however, showed no significant differences in attainment from those who never played with friends at home. It may be that children who frequently have friends at home to play with receive relatively less interaction with adults and that this may account for their relatively lower language scores.

Children whose parents reported no developmental problems showed higher pre-reading, early number concepts and language scores than those whose parents reported a problem.

Effect sizes

To further illustrate the impact of different background factors on attainment at reception entry effect sizes (ES) were calculated. Effect sizes are most commonly used in experimental studies and essentially measure the strength of mean differences. Glass *et al.* (1981) define ES as:

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

Or

$$\Delta = \frac{\overline{X}_{\text{Exp}} - \overline{X}_{\text{Cont}}}{SD_{\text{pooled}}}$$

Effect sizes were calculated for different child outcomes, using both the child-level variance and coefficients for predictors included in the multilevel statistical models (shown in Appendix 1) adopting the formulae outlined by Tymms *et al.* (1997). This method was also used by Strand (2002) in a study of KS1 attainment.

For categorical predictors (e.g. gender or ethnic group) the effect size was calculated as:

ES=categorical predictor variable coefficient/√child level variance

Or

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

For continuous predictor variables (e.g. child age in months), the effect size describes the change on the outcome measure produced by a change of +/− one standard deviation on the continuous predictor variable, standardized by the within-school SD, adjusted for covariates in the model—the level 1 SD:

$$\Delta = \frac{2\beta_1}{\sigma_e} * sd_{x1}$$

Effect sizes can be useful for comparisons between different studies but interpretations must be made with caution and with reference to the outcomes concerned and controls used in models (Elliot & Sammons, 2003). For further discussion of effect sizes see Coe (2002).

As might be expected, the EAL impact on language attainment was substantial (ES 1.0). Of the family measures, mother's qualification also had a strong impact on language (e.g. mother having a degree versus no qualification, ES 0.62). For pre-reading mother having a degree had an ES of 0.45, while for early number concepts the ES was 0.39. For family SES unskilled manual versus professional group the ES for language was 0.54, for pre-reading 0.58 and for early number 0.51.

Several of the measures related to aspects of home learning showed a moderate effect on language (ES 0.3–0.36). Specific measures (such as 'teaching' the alphabet) were especially important for pre-reading (ES 0.62). Further analyses were conducted using a home learning environment (HLE) index, which provides a summary based on all the home learning measures reported earlier. Children's scores on this measure were divided into five groups: very high, high, moderate, limited and minimal. The effect size for the HLE index (very high group compared with minimal) on language attainment was 0.85. This is higher than that identified for family measures such as mother's qualification level and SES.

The impact of pre-school

Home children were classified as those who had experienced less than 10 weeks at two sessions per week (i.e. less than 50 hours) at a pre-school centre before entering primary school. It had been planned to recruit 500 home children from amongst children starting at primary schools that the main EPPE pre-school sample entered. The recruitment of home children proved difficult, reflecting the increased access to, and take-up of, pre-school provision during the 1990s. In total, 314 home children were recruited from 96 different primary schools. The main reasons reported by parents for keeping children at home 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. Other reasons were that the available provision did not fit parental work patterns, it was unaffordable or parents were

Table 6. Multilevel results showing the net impact of no pre-school provision on attainment in raw score points

	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.

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.

Siraj-Blatchford *et al.* (1999) surveyed LAs in the EPPE study, and found areas where there was a lack of early years provision or lack of knowledge about the provision that existed. The sample of 'home' children reflects this pattern. Clusters of 'home' children were recruited to the sample in some areas from particular schools, with an overrepresentation of minority ethnic groups. The home sample is probably therefore typical of the way in which 'pockets' of home children are unevenly distributed in some localities.

Contextualized multilevel analyses were used to establish 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 important impact of differences in child, parent and home learning environment characteristics described earlier. The cognitive attainments of children with varying durations of pre-school provision were made, including those with no provision (home children) as the base reference group.

Table 6 shows that home children have significantly poorer attainment compared with children who have had pre-school experience, even when account is taken of the impact of background influences. 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. Similarly, data for early number reveal an increase of 2.0 points for pre-school versus home as compared with a 1.5 points increase for having a mother with A levels.

In terms of effect sizes, the strongest impact of any pre-school experience versus none is on language development (ES 0.44) and early number concepts, (ES 0.44), with a more moderate effect for pre-reading (ES 0.28).

Elsewhere we have reported differences in social behavioural development. These show a significant positive impact for comparisons of the main EPPE pre-school and home sample on three areas: Peer sociability, Independence and concentration, and Cooperation and conformity, the strongest ES being for Peer sociability (Sammons *et al.*, 2003).

Table 7. Multilevel results showing the net impact of 'duration' of pre-school on attainment at entry to primary school

Compared to no pre-school experience, i.e. home children	Pre-reading	Early number concepts	Language
< 1 yr pre-school	1.189 (1.027)	1.517* (0.460)	2.689* (0.611)
1– yrs pre-school	2.641* (0.979)	2.012* (0.441)	2.234* (0.544)
2–3 yrs pre-school	3.723* (1.013)	2.502* (0.458)	2.522* (0.568)
> 3 yrs pre-school	4.633* (1.135)	2.467* (0.516)	3.630* (0.631)

* Statistically significant at 0.05 level.

The impact of pre-school provision was further 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 year 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 7 shows the results of analyses measuring the 'duration' of pre-school in addition to child, parent and home environment factors. In general, children who had spent more time in pre-school had significantly higher cognitive attainments than the home sample for pre-reading, early number and language. The differences tended to be largest for those who had spent three years plus at a pre-school centre compared with none, controlling for other factors.

Figure 1 summarizes the findings in terms of effect sizes, which allows the relative strength of the impact of different periods of time in a target pre-school to be ascertained across different outcomes. In general, these results show that the longer a child was in a target pre-school centre, the stronger the positive impact on attainment. Effect sizes for those with 2–3 years or more than 3 years in pre-school compared with none (the home group) tend to be larger (ranging from 0.44 to 0.63 for language, 0.54 to 0.55 for early number and 0.38 to 0.48 for pre-reading). The effect sizes for 2–3, or more than 3 years' pre-school are similar in size to those attributable to mother having a degree versus none. For comparison, mother having a degree versus no qualification showed ES 0.39 for early number, 0.45 for pre-reading, 0.62 for language.

Comparisons with the home group also indicate that one year of pre-school centre experience has relatively less impact on attainment in pre-reading (ES 0.12) than in either language (ES 0.47) or early number concepts (ES 0.33). By making additional comparisons of the difference in effect sizes between groups of children in the pre-school sample who had varying amounts of experience, we can obtain a further indication of the typical effect of an additional year of pre-school for different

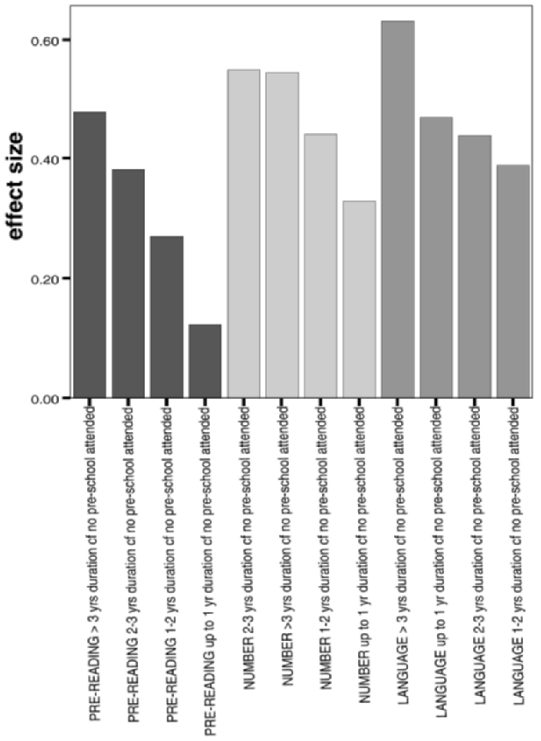

Figure 1. Effect sizes for amount of pre-school experience compared with none on cognitive attainment

outcomes, controlling for the impact of child, family and home learning. For pre-reading attainment the difference in ES is 0.15 between children who had less than one year compared with 1–2 years in a target centre. For early number the difference in ES is 0.11. One anomaly is the relatively strong effect of up to one year for language attainment, which is slightly larger than that for all other groups except the 3-year plus group.

Discussion

In England some form of pre-school experience in an institutional setting has become the norm for young children prior to the start of school. During the 1990s different governments adopted a range of policies, which expanded the availability of pre-school places. The care and education roles of pre-school have been debated and the early years are now recognized as important in their own right as well as for preparing young children for a better start at primary school. From 1997 (the year EPPE started to recruit the pre-school sample) early years policy encouraged local integration, bringing together education and care, and increased the supply of free places for children aged four and an agreed percentage of those aged three years. Early Years

Development and Care Partnerships were created to bring together the range of providers of services for young children and national guidelines published. Major initiatives such as Sure Start and Early Excellence centres were also promoted (see Jackson, 2000).

The EPPE study was designed to investigate the impact of pre-schools on young children's developmental outcomes. The main findings on the effectiveness of different pre-school centres and types of provision using analyses of cognitive and developmental progress over the pre-school period are reported elsewhere (Sammons *et al.*, 2002, 2003). This article focuses specifically on patterns of cognitive attainment at the start of primary school, with particular reference to comparisons between an additional home group recruited at school entry and the main EPPE pre-school sample. Multilevel models explored the impact of child, parent and home environment factors as well as duration of pre-school centre experience.

The analyses show that, while remaining important predictors of attainment, child, parent and home environment characteristics of children do not fully account for differences in attainment between the home group and the main pre-school sample. The attainment gap suggests that a pre-school experience can help reduce the inequality in cognitive development associated with more disadvantaged backgrounds. Nonetheless, background factors remain powerfully associated with variations in young children's attainment when children start primary school (age rising five years), especially for language. This points to the need for more intensive work on language enrichment for young children who show poor language development at the start of pre-school. Home children showed particularly poor language attainment when they start school, and this is not just attributable to EAL status, ethnic background and greater socio-economic disadvantage. Mixing with other children and adults in a pre-school setting appears to boost language development for all groups. Significant benefits in terms of better development of pre-reading and early number concepts are also evident.

The analyses show that the choice of school entry measures may have equity implications. It is therefore important that accurate measures of children's attainments at school entry are obtained covering a range of domains so that different areas of strength/weakness can be assessed and children receive additional support or appropriate challenge. A focus on mainly language-based measures for school reception assessment may disadvantage some children of particular ethnic/language backgrounds.

The importance of the home learning environment for young children's cognitive attainment is highlighted in the primary school entry results. This result is in line with earlier findings (Sammons *et al.*, 1999; Melhuish *et al.*, 2001) on its impact for cognitive attainment at entry to the pre-school study (see also discussions by Sylva & MacPherson, 2002).

Duration of pre-school also has an important impact on 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 three years of age (mainly associated with three types of provision, local authority day nursery, private day nursery and integrated

centre) had higher cognitive attainments (assessed at three years) than those who started later. However, the minority who started below two years of age did not show more positive outcomes than those who started at age 24-30 months. This cognitive advantage for an early start was still evident when children entered primary 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, because of their very different characteristics. A controlled experiment (not feasible on ethical or practical grounds) would be needed to draw firm conclusions. Nonetheless, the analyses of attainment 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 much poorer than those of children who had attended pre-school. This result, combined with findings on the advantages of an early start date, indicates that pre-schooling has a positive impact on cognitive development. Vulnerable children (those from disadvantaged backgrounds) without pre-school centre experience are therefore likely to be at a particular disadvantage when they start primary school and may require additional support.

The EPPE research suggests that pre-school can play an important part in combating social exclusion by offering disadvantaged children, in particular, a better start to primary school. The research also points to the separate and significant positive influence of the home learning environment. Strategies which encourage and support greater parental engagement in home learning activities (teaching songs/ nursery rhymes, reading to young children, playing with letters and numbers, drawing and painting) for the most vulnerable are also likely to show benefits in terms of children's subsequent cognitive and social behavioural development.

The EPPE findings are in line with those reported from the National Institute of Child Health and Development study of early childcare and children's development prior to school entry in the USA (NICHD, 2002). However the NICHD study did not employ an educational effectiveness design and so could not investigate the impact of individual pre-school centres (a main aim for EPPE but not covered in this article). The NICHD research points to the strength and relative independence of quantity, quality and type of childcare for children's development. 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. The NICHD study, however, notes that it has some limitations in relation to detecting the strength of both childcare and parenting effects because the sampling plan excluded some high-risk families (NICHD, 2002, p. 158) 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 have improved the ability to measure the impact of child, family and home environment characteristics as well as pre-school effects. The correspondence in findings on the importance of early childcare between EPPE and the NICHD study conducted in a different context and using different research designs, suggests that conclusions concerning the positive impact of pre-school are well founded.

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Note

1. Only a small number of integrated centres were included because few examples of this form of pre-school provision existed at the start of the project.

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Appendix 1. Results from contextualized multilevel analyses

Table A1. Pre-reading contextualized model

n=2659	Estimate	SE
Gender (girls compared to boys)	2.404*	0.397
Age at outcome test (centred on 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
Birth weight (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)		
Vocational	0.781	0.807
Academic age 16	1.010	0.693
Academic age 18	1.218	0.946
Degree	2.235*	0.927
Higher	1.871	1.291
Other	−1.093	2.007
Absent father	0.074	0.682
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

Table A1. *Continued*

n=2659	Estimate	SE
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 on mean)	0946*	0.325

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

Table A2. Early number concepts contextualized model

n=2677 children	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
Birth weight (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

Table A2. *Continued*

n=2677 children	Estimate	SE
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 on mean)	−0.052	0.148

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

Table A3. Language contextualized model

n=2691 children	Estimate	SE
Age at outcome test (centred on 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
Birth weight (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

Table A3. *Continued*

n=2691 children	Estimate	SE
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
1–2years	2.234*	0.544
2–3 years	2.552*	0.568
More than 3 years	3.630*	0.631
Duration of reception (centred on mean)	−0.249	0.168

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