RESEARCH

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EFFECTIVE PRE-SCHOOL AND PRIMARY EDUCATION 3-11 PROJECT (EPPE 3-11)
INFLUENCES ON CHILDREN'S ATTAINMENT AND PROGRESS IN KEY STAGE 2: COGNITIVE OUTCOMES IN YEAR 5

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Effective Pre-School and Primary Education 3-11 (EPPE 3-11) (2003-2008) builds on the work of the earlier Effective Provision of Pre-School Education (EPPE) project (1996-2003) which investigated the impact of pre-school provision on a national sample of young children in England between the ages of 3 and 7 years. EPPE 3-11 is following the same sample of around 2,500 children to age 11, the end of Key Stage 2. This Research Brief focuses on the relationships between various child, family, home, pre-school and primary school characteristics and measures of children's cognitive attainment in Year 5 of primary school (age 10). It compares these findings to the impact of the same factors when the children were in Year 1 (age 6). The brief also reports findings about the combined influence of pre-school and primary school experience on children's cognitive attainment in Year 5.

Key Findings

The key findings are reported in terms of the three main sets of influences studied: child/family; evidence of continuing pre-school influence; and the contribution of the primary school attended.

Child, Family and Background effects

- The quality of the early years home learning environment (HLE) and parents' (especially mothers') qualification levels are the most important background factors relating to a child's attainment in reading and mathematics at Year 5, followed by low birth weight, need for support with English as an additional language (EAL), early health or developmental problems and socio-economic status.
- Taken together, child, family and home influences on children's attainment in reading and mathematics in Year 5 are weaker predictors than they were in Year 1. This is likely to indicate the increased primary school and peer group influence.

Pre-school effects

- There is evidence of a continuing positive effect of attending higher quality or more effective pre-school settings on children's subsequent outcomes in mathematics and reading at the end of Year 5, once the influence of background factors has been taken into account.
- Those children who attended low quality pre-school no longer show cognitive benefits by Year 5; their results are not significantly different from the children who did not attend pre-school. This is a change in comparison to earlier findings at age 5 (the start of primary school) when all pre-school experience was found to be beneficial.

Primary school effects

- The academic effectiveness of the primary school a child attends (as measured by independently conducted value added analyses of national assessment results for 2002-2004) was a significant factor in accounting for variation in EPPE children's reading and mathematics attainment in Year 5. Children who attended a primary school identified as academically more effective had better outcomes at age 10 than children who

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- attended a less effective primary school, after allowing for the influence of child, home and pre-school factors.
- Attending a more academically effective primary school was more important for the later attainment of children who had not attended pre-school or who had attended a low quality pre-school than to those children who had attended a more effective or higher quality pre-school.
- Equally, early experience of attending a better quality or more effective pre-school appeared to act as a protective factor against the limitations of later moving to a less academically effective primary school, in terms of fostering better reading and mathematics outcomes in Year 5.
- Overall the results indicate that the combined influence of attending a better pre-school and a more academically effective primary school can give a significant boost to children's later cognitive outcomes at age 10, especially for mathematics. This effect is similar in size to the impact of having a high rather than a low Home Learning Environment or a mother with the highest level of educational qualifications (a degree or above) rather than none.

The EPPE 3-11 Research: Background

The original EPPE study monitored children's intellectual and social behavioural development between the ages of 3–7 years. The EPPE 3-11 extension follows up the sample to the end of primary school (age 11 years). The EPPE website: www.ioe.ac.uk/projects/eppe gives further details about the study and the sample.

This Research Brief reports on a range of analyses related to the cognitive progress of all children in the EPPE3-11 sample. The focus is on exploring the factors that predict children's reading and mathematics attainment in Year 5 (age 10 years).

In addition to exploring background and continuing pre-school effects, the study investigates the influence of primary school on children's outcomes and the way primary school and pre-school influences jointly affect children's attainment.

This Research Brief outlines the analysis strategy used to examine the relationships between child, family and home learning environment factors and children's cognitive attainment at the end of Year 5. Changes in the effects of these factors on attainment between Year 1 and Year 5 are compared. The additional effects of pre-school and primary school experience are then explored.

For further details on the research and analyses used in this study see the Summary report and full Technical report (Sammons et al., 2007a,b). A separate report will provide equivalent information about important social/behavioural outcomes for the same child sample in Year 5.

Analysis Strategy

The findings reported here are based on analyses of a wide range of quantitative data about children's development, child, family and home learning environment (HLE) characteristics and the characteristics of the pre-schools attended. It is important to consider the influence of background on attainment outcomes in order to investigate net pre-school and primary school effects, because pre-schools and primary schools differ considerably in the characteristics of their child/pupil intakes.

Additional 'value added' measures of overall primary school academic effectiveness have been derived from independent statistical analyses of national data sets conducted for all primary schools in England based on successive (2002-2004) pupil cohorts (Melhuish et al., 2006) as part of this study. These have been incorporated into the child databases to provide indicators of the academic effectiveness of the primary school attended by each child in the EPPE3-11 sample to complement the measures on pre-school settings collected previously.

Standardised NFER tests of reading and mathematics were administered to provide measures of children's educational outcomes in Year 1 and again in Year 5. Primary Reading NFER Nelson Level 1 and 2 were appropriate for the age range of the sample. Tests were administered to relevant cohorts in the spring term of 2003-2006[1].

Statistical analyses (using multilevel models) investigated the influence of different child, family and HLE background factors on children's

[1] The EPPE sample was recruited at entry to the pre-school study and covered four age cohorts reflecting differences in their ages. This means that the NFER tests were administered in four successive years when pupils were in Year 5 of primary school.

attainment at the end of Year 5. These analyses identify the unique (net) contribution of particular factors to variations in children's outcomes, while other background influences are controlled for. 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, ethnic groups etc. This is important because the research shows that much of the apparent difference in attainment associated with certain characteristics, for example, ethnic group membership, is attributable to the impact of other socio-economic and demographic factors (e.g. birth weight, income, language, family SES, parents' qualification levels and HLE). It also means that analyses of any continuing pre-school effects and primary school influences on children's outcomes in Year 5 as well as their joint effects, include control for the influence of background factors.

Similar analyses were conducted when the children were in Year 1 (age 6) enabling comparisons to be made with the latest results in Year 5. We investigated the progress made by different pupil groups during Key Stage 2, and sought to establish the changing impact of individual background factors on attainment as children move through primary school.

The Findings

Background and home learning factors

The impact of background characteristics was explored to identify the size of the equity gap in attainment for different demographic factors and whether the influence of demographic factors had increased or decreased across Key Stage 2 between Years 1 and 5.

Child characteristics - At the end of Year 5, gender differences were identified, with girls doing better than boys in reading. Boys tended to show higher attainment than girls in mathematics. Children with very low birth weight had significantly lower attainment in both reading and mathematics. Children from larger families (with 3 or more siblings) and those with early developmental problems, showed significantly lower attainment in reading.

Children who needed support for English as an Additional Language (EAL) showed lower average attainment in reading and mathematics (with stronger effects for mathematics than reading). For ethnic groups, reading attainment for Bangladeshi and White European children was significantly lower whilst in mathematics, Indian children showed particularly high attainment by Year 5. It should be stressed that differences relating to ethnic groups and mother tongue identified here are net of the influences of all other factors including SES and mother's qualification level in which there are also significant differences between ethnic groups.

Family characteristics - Being from a family with low income (measured by entitlement to free school meals [FSM]) showed a negative relationship with attainment.

Mother's education level shows significant positive effects that were stronger than found at earlier time points, especially for reading. Although father's highest qualification also has a statistically significant effect on attainment, mother's highest qualification showed a stronger link to children's attainment at Year 5, again in line with earlier findings.

All socio-economic groups (SES) that were lower than 'professional non-manual' were associated with lower attainment levels for both reading and mathematics with significantly lower attainment for children whose parents belong to the groups 'skilled non-manual', 'skilled manual' and 'semi-skilled' in mathematics. In reading, the category 'unskilled' was also associated with significantly lower attainment.

The Early Years Home Learning Environment (HLE) - The early years HLE is a measure of the quality of the home learning environment during the pre-school period, made up of parents' reports of specific learning activities undertaken in the home. Sammons et al., (2002; 2003) gives more details on the items in this index and reports on its impact on children when they started primary school. In these Year 5 analyses, the early years HLE is found to be a powerful predictor of better cognitive attainment at age 10 even after 5 years in primary school. It had a slightly stronger effect on reading and mathematics (and had a similar effect size as for a mother with a degree compared to a mother with no qualification). There are only modest correlations between HLE and parents' highest qualification levels.

The most important background, child and family factors - The influence of different single predictors was evaluated in terms of net effect sizes (ES). This provides a measure of relative strength of association for a single predictor while simultaneously controlling for the influence of other significant factors. An ES of size 0.5 can be viewed as a fairly strong predictor, one of size 0.2 as moderate.

The most important background predictors for reading and mathematics were mother's highest level of qualification (reading: ES = 0.64, mathematics: ES = 0.54, for children whose mother had a degree compared to no qualification) and early years HLE (reading: ES = 0.61, mathematics: ES = 0.57 for the highest HLE-category compared to the lowest HLE-category). For comparison: The effect size of the statistically significant gender effect in reading was weaker at 0.10.

Changes in the impact of family background (from Year 1 to Year 5)

Child characteristics - Girls still showed higher attainment than boys in reading in Year 5 (as they did in Year 1). The results for boys in mathematics show a reversal at Year 5 compared to Year 1; as a group they had not only caught up with, but had overtaken, the girls.

At Year 1 and Year 5, children with very low birth weight showed lower cognitive scores but the strength of the effect decreased for both reading and mathematics by Year 5. Family size has also lost some of its impact on attainment in reading. Being identified as having early developmental problems has increased in its impact on attainment in reading but slightly decreased for mathematics. Although children who needed EAL support were still showing lower attainment in reading, the relative attainment 'gap' compared with other children decreased.

Given the relatively small sizes of some ethnic groups in the EPPE 3-11 sample the results by ethnicity should be interpreted with caution. The results show the importance of taking account of other demographic influences that affect attainment for all children as they account for much of the differences in average attainment level found for different ethnic groups. However, having taken account of these factors some ethnic groups still show lower or higher attainments in reading and mathematics than White UK children.

Comparisons between the White UK children and other ethnic groups reveal the following: Black African children had slightly higher attainment in reading in Year 1 but have fallen behind at the end of Year 5. Other ethnic groups have stayed at the same level in reading (see Sammons et al., 2007b for full details). For mathematics in Year 1 Indian children had relatively lower scores than White UK children, whereas by Year 5 they have not only closed the gap but had significantly higher scores. Black African children have fallen further behind in mathematics, whereas Pakistani and Bangladeshi children have improved their attainments relative to White UK children during Key Stage 2.

Family characteristics - The impact of mother's highest qualification on cognitive outcomes show that this had become even stronger at the end of Year 5 than it was at Year 1, especially for reading. The father's highest qualification (although relatively less important than the mother's) had become stronger for attainment in mathematics.

For attainment in reading, the SES gap between Year 1 and Year 5 has become slightly wider but this is not the same for mathematics, where the pattern is more inconsistent with an overall slight decrease. The impact of low income (measured by eligibility for free school meal status FSM) though remaining moderate has become slightly stronger for attainment in reading (ES 0.27) but is little changed for attainment in mathematics (ES 0.22).

The Early Years Home Learning Environment (HLE)

The quality of the early years HLE a child experienced during the pre-school period was still found to be a very important factor for academic outcomes in Year 5, controlling for all the other background variables. In fact it was one of the strongest predictors of cognitive outcomes in the analyses. For attainment in reading the influence of HLE seems to be of the same strength as in Year 1 (change in ES approximately 0.05) but in mathematics the impact has slightly decreased (change in ES between 0.06 and 0.14).

The impact of pre-school

Given previous findings that pre-school experience gave children a better start to school (see Sammons et al., 2002; 2003), an important aim of the analyses was to establish whether there was any longer term continuing pre-school influence in Year 5 and to explore the influence of primary

school. Earlier follow ups to Year 2 had found continuing pre-school effects across Key Stage 1.

In contrast to findings at entry to primary school (age rising 5 years) and at age 7, two of the four pre-school measures used no longer showed a statistically significant relationship with reading or mathematics attainment at age 10. These two were whether or not a child had simply attended any pre-school centre or not, and the duration of time in months in pre-school where they had. The two other indicators - related to the *quality* and the *effectiveness* of the particular pre-school attended - were still found to be predictors of better cognitive outcomes in Year 5.

Quality[2] *and effectiveness*[3] *of pre-school* - There were small but significant differences in attainment in reading associated with pre-school quality. Children who attended a low quality as opposed to a high quality pre-school setting (ES 0.15) had significantly lower attainment, this was similar in size to the effect of gender. At 10 years old, children who had not attended any pre-school also showed no worse outcomes in reading than those children who had attended a low quality pre-school, but poorer results than those who had attended a medium or high quality pre-school. The results on quality of pre-schooling for mathematics were weaker. Attending a high quality pre-school appears to be relatively more important in long term reading achievement than in mathematics, where attending a medium quality pre-school also provided a small boost.

Similarly the effectiveness of the pre-school attended still showed a modest positive impact on children's subsequent attainment in both reading and mathematics in Year 5. Children who had attended a more effective pre-school showed significantly better attainment in Year 5 than children who had attended no or only a low effective pre-school. These results were somewhat stronger for mathematics (ES between 0.20-0.25 for the highly effective pre-school categories).

Pre-school quality was more influential in shaping later reading outcomes while pre-school effectiveness in promoting early number concepts was more influential for later outcomes in mathematics in Year 5.

The combined impact of pre-school and early years HLE - Children who had experienced a high early years HLE and also went to a medium or high quality pre-school showed the strongest positive long term benefit in reading by Year 5. Children who did not attend pre-school also benefit particularly from high early years HLE and interestingly, they show higher reading achievement than high early years HLE children who went to low quality pre-schools. But for children who had low early years HLE, those who went to a high quality pre-school showed better attainment at Year 5 than children with similar characteristics who did not attend pre-school. These findings underline the positive benefits both of high quality pre-school and of good early home learning environment, in line with findings for the same children at younger ages. They also illustrate the way the two combine to influence children's development in the longer term.

Different pre-school effects for less and more disadvantaged children

Higher quality and more effective pre-school appears to give a long term boost for all children but for the most disadvantaged children only high quality is associated with a significant long term boost. Lower quality pre-school appears to offer no long term attainment benefit in Year 5, this was more apparent for disadvantaged children. Again, this highlights the importance of quality in pre-school intervention, especially for the most vulnerable groups of young children.

The impact of primary school academic effectiveness

Children in the EPPE3-11 sample who went on to attend a very high, high or medium academically effective primary school (in terms of value added progress in national assessment results) were found to obtain significantly better scores in NFER tests of mathematics in Year 5 than children who had attended a low effective primary school. The ES was 0.29 - stronger than the effect of FSM (ES 0.22 for mathematics, for example).

Likewise, EPPE3-11 children who went on to attend a very high or highly academically effective primary

[2] *Quality* of pre-school was based on observations in each centre, using rating scales (see Sylva et al., 2004).

[3] *Effectiveness* of pre-school was derived from a 'value added' model of EPPE children's progress across 141 pre-school settings (after controlling for prior attainment and background factors). Pre-school centres where children made more progress in pre-reading or early number concepts were classified as more effective (see Sammons et al., 2002).

school (in value added terms in national assessments of English) were also found to have significantly better reading skills by Year 5 in NFER tests than children who had attended a low effective primary school. The ES was somewhat weaker than that found for mathematics, however at 0.19.

These results indicate that the variations in academic effectiveness identified between primary schools, as measured by our independently derived value added indicators, have a significant influence on children's attainment in other measures and at other time points (standardised NFER tests), over and above the influence of child and family background and HLE. Children who attend a less academically effective school are likely to do significantly less well by Year 5, especially in mathematics, taking other factors into account. For disadvantaged children, attending a less academically effective primary school is likely to further increase the achievement gap.

The combined impact of pre- and primary school effectiveness

Further analyses investigated the joint influences of pre-school and primary school on attainment outcomes in Year 5. The research provides new evidence concerning the *combined* effects of pre-school and primary school in shaping children's educational outcomes. These analyses sought to establish whether going to a high quality or more effective pre-school had a protective impact if a child subsequently went on to a less academically effective primary school (in value added terms). We also investigated whether home children or those who went to a less effective or low quality pre-school did better later if they went to a more academically effective primary school.

For reading: at Year 5, children who did not attend pre-school achieved better reading outcomes if they went to a medium/high academically effective primary school than a low effective one (ES 0.17). Children who did not attend pre-school and went to a low effective primary school had the lowest reading outcomes. Children who attended a low quality pre-school centre also showed little extra benefit in reading in Year 5 even if they went on to attend a medium or highly effective primary school compared with home children who went to a low effective primary. Children who attended a medium or high quality pre-school centre showed better reading attainment outcomes in Year 5 and were less affected by the academic effectiveness of the primary school. We conclude, therefore, that attending a higher quality pre-school seems to have some protective effect in terms of later reading outcomes for children who go on to less academically effective primary schools.

For mathematics: at Year 5, results on continued pre-school effects are stronger than for reading. Children who did not go to pre-school and who attended a low effectiveness primary school had significantly lower attainment than all other pupil groups by Year 5. In all groups, including children who did not go to pre-school, there was a strong benefit from attending a more academically effective primary school compared with the home group (ES in range 0.47-0.53). Nonetheless, children who went to a low or medium quality pre-school centre and low effective primary school later on were still doing better than those children who did not have any pre-school experience and went to a low effective primary school. Children who went to high quality pre-school were doing particularly well, even if they went on to attend a low academically effective primary school (again indicative of a protective benefit of pre-school). Children who went to a high quality pre-school centre and a medium/high effective primary school, showed the most positive effect (ES 0.53) in Year 5 controlling for the impact of all other background factors.

Implications

The results show that the relative advantage of attending good quality and highly effective pre-school on cognitive outcomes persists to Year 5. However this advantage reduces over time and is less at Year 5 than at entry to primary school. Although the effects of pre-school are generally stronger for more advantaged children, it is important to note that children from more disadvantaged backgrounds are still attaining higher scores by Year 5 compared to their peers with similar backgrounds who did not have the benefit of high quality pre-school experience.

The research also reveals the strong influence of the early years HLE but also highlights interesting interactions. An important finding is that the effects of pre-school are, in part, influenced by the child's home experiences – particularly the HLE. Raising the quality of learning in *both* the home and pre-school are likely to be more successful in improving children's developmental trajectories,

especially for disadvantaged groups, than concentrating on either in isolation.
In addition the research points to the important influence of the academic effectiveness of the primary school that children go on to attend, particularly in fostering better mathematics attainment in Year 5.

No one factor is the key to raising children's attainment and promoting cognitive progress – it is the *combination* of experiences over time that matters. The child who has a better early years HLE, experiences a high quality, more effective pre-school setting and who then goes on to attend a more academically effective primary school has a combination of 'protective' experiences that benefit current and future educational attainment. They are unlikely to overcome all the powerful effects related to child and family background, but their collective contribution can substantially moderate them (see EPPE Team Report, 2007 for further discussion of equity implications).

The results demonstrate that primary schools that are successful in 'value added' terms offer benefits to children's longer term attainments in reading and maths. This is likely to be particularly beneficial for more disadvantaged groups of pupils given evidence of a significant attainment gap from age 3+ years at the start of the EPPE research. In addition, they also indicate that the quality of the pre-school environment (at home and in pre-school settings) has long term implications for children's later outcomes. The findings suggest that interventions to improve the pre-school and home learning experiences of children are likely to offer some protection against ineffective primary schooling. Similarly, attending an academically more effective primary school offers benefits to children, particularly those who did not attend pre-school and those who attended low quality pre-school.

Methodology

The EPPE 3-11 project contains a series of three 'nested' studies or 'tiers' which help answer specific research questions (www.ioe.ac.uk/projects/eppe).

Tier 1 answers the research question about the effectiveness of the 950+ primary schools the EPPE 3-11 children attended. It used statistical data (matched KS1 and KS2 national assessment results) for successive pupil cohorts derived from every primary school in the country (over three consecutive years 2002-2004) for English and mathematics to provide value added estimates of the academic effectiveness of each school. Further information on Tier 1 can be found in Melhuish et al., (2006a, b).

Tier 2, on which this research brief is based, involved collection of information on academic and social behavioural development for every child in the sample in spring term of Year 5, during 2003-2006. The analyses involved a sample of 2556 pupils from the original longitudinal EPPE research study tracked from pre-school entry to the end of Year 2 of primary school (age 3+ to 7 years) for whom reading and mathematics data were collected in the spring term of Year 5 (age 10). The sample were originally drawn from 141 pre-school centres covering 6 types of provision (nursery classes, nursery schools, integrated settings, playgroups, private day nurseries and local authority day nurseries) and included a group of home pupils who had not attended pre-school. The research included independent measures of the academic effectiveness of the primary school attended by children in the sample (based on the Tier 1 analyses described above).

The full report (Sammons et al., 2007b, EPPE 2007) on which this research brief is based can be found on the EPPE website. A summary version is available from the DfES - Sammons et al., 2007a.

Tier 3 explored classroom practice through two different but complementary classroom observations. This addresses the question of what constitutes good classroom practice in Year 5 and what makes effective primary schooling. The results show that, over and above background factors, school matters in shaping children's developmental trajectories. See Sammons et al., (2006).

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