Changes in Children's Cognitive Development at the Start of School in England 2001-2008

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His main research interests include monitoring, assessment, interventions and research methodology generally. He devised the PIPS project, which is designed to monitor the affective and cognitive progress of children through primary schools starting with a computer adaptive on-entry baseline assessment which is used in thousands of schools.

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Abstract

Since 1997, England has seen massive changes in the Early Years including the introduction of an early childhood curriculum, free pre-school education for three-year-olds and local programmes for disadvantaged communities. Many of these initiatives took time to introduce and become established. Beginning in 2001, and each year thereafter until 2008, the authors collected consistent data from thousands of children when they started school at the age of four on a range of variables, chosen because they are good predictors of later success. These included vocabulary, early reading and early mathematics. Children from the same set of four hundred and seventy two state primary schools in England were assessed each year. This paper contributes to the existing studies of educational trends over time by examining the extent to which children's scores on these measures changed over that period; in general, they were found to have remained stable.

Introduction

Since 1997, the English government has introduced several national and local initiatives intended to enhance the lives of children in England and to reduce the impact of poverty and social deprivation. Good quality childcare and education in the early years have been a high national priority and education in the early years was one of the main provisions of the 2002 Education Act (HM Government, 2002). Many of the initiatives have not only sought to improve the teaching and learning of young children but also to support the needs of the whole family by providing integrated services such as pre-school care in the same location as adult education and health facilities.

The Act introduced the Foundation Stage of the National Curriculum for children from the age of 3 to the end of the first year at school at the age of 5 (Statutory Instrument, 2003a). Prior to that time, although state and private pre-school provision did exist, and most children attended a full year at school at the age of four, there was no requirement to follow a common curriculum. The Foundation Stage has specific curriculum guidance across six areas of learning[1] and a statutory assessment, the Foundation Stage Profile, which uses practitioners' observations to assess each child's attainment at the end of the Stage (Statutory Instrument, 2003b). In September 2008, the statutory assessment arrangements for the Early Years Foundation Stage were changed and although the Foundation Stage Profile remained in place, the way in which the scales were assessed consisted largely of practitioner observations of child initiated activities (Qualifications and Curriculum Authority, 2008). From April

[1] The six areas of learning are: 1) Personal, Social and Emotional Development, 2) Communication, Language and Literacy, 3) Mathematical Development, 4) Knowledge and Understanding of the World, 5) Physical Development, 6) Creative Development.

2004, all children in England were entitled to a free part-time early education place when they were three years old although they are not legally required to start attending school until the start of the term after their fifth birthday[2]. In practice 95% of children aged 3 and 4 in England accessed some free early education, some run by local authorities, others by voluntary and private sectors (Department for Children, Schools and Families (DCSF), 2009). It can be part-time (the free place offered by the government consists of a minimum of five sessions of two and a half hours' early years education per week for 33 weeks per year), full-time or, for parents in full-time employment, care that extends beyond the school-day.

Some Early Years initiatives have had a wider scope. For example, 'Sure Start' is an ongoing, widely implemented initiative supported by the Government that aims to achieve better outcomes for children, parents and communities (Sure Start, 2007). The focus of many initiatives has been on children in deprived circumstances because it is well known that socio-economic status is related to academic achievement (see for example Bourdieu and Passeron, 1977; Raffo, Dyson, Gunter, Hall, Jones and Kalambouka, 2007) and evidence from previous studies, particularly the Head Start and the Perry Pre-School programmes in the United States of America, have demonstrated that comprehensive early years interventions can make a difference to children's lives and help to reduce the link to deprivation (Barnett, 1995; Karoly, Greenwood, Everingham, Hoube, Kilburn, Rydell, Sanders and Chiesa, 1998; Ramey and Campbell, 1991; Reynolds, Temple, Robertson and Mann, 2001; Schweinhart, Barnes and Weikhart, 1993; Schweinhart, 1996; Schweinhart and Weikart, 1997). The evidence (Schweinhart et al., 1993 and 1996) suggests that when the recipients of

[2] The small proportion who are home educated do not have to attend school.

the Perry Pre-School intervention reached adulthood they had higher earnings, engaged in less criminal behaviour, completed more years of education and were more likely to own their home than those children randomly assigned to the control groups. Gilliam and Zigler (2000) conducted a meta-analysis of all evaluations of U.S. state-funded pre-school from 1977 – 1998. The pattern of overall findings from the analysis offered modest support for positive impacts in improving children's development, improving later school attendance and performance, and reducing subsequent grade retention. Significant impacts were mostly limited to kindergarten and first grade; however, some were sustained several years beyond this period.

The evidence from programmes implemented and evaluated in the U.S.A. and the Effective Pre-School and Primary Education (EPPE) 3-11 cohort study conducted in England was considered in the development of Sure Start, which is predominantly aimed at deprived neighbourhoods (Melhuish, 2007a; Melhuish, 2007b; Taggart, Sylva, Melhuish, Siraj-Blatchford and Sammons, 2007). The Sure Start initiative in England was delivered through local programmes, each intended to be tailored to the context and needs of different areas. These Sure Start Local Programmes (SSLPs), which were set up to improve the well-being, attainments and life chances of all children from birth to four years old in each area and to support their families, offered a wide variety of services and facilities. The first round of sixty SSLPs was set up in 1999, working to bring together early education, childcare, health and family support for the benefit of children in disadvantaged areas. By 2004, there were five hundred and twenty four SSLPs established aimed at helping almost half a million children living in disadvantaged areas. Most of the communities in these 524 SSLPs have a Children's Centre, and it is the aim of the government to establish a Children's Centre

in every community by the year 2010. Children's Centres are places where children under 5 years of age and their families can receive integrated education, care, family support, health services and support with employment (Sure Start, 2008). It is too soon to be able to comment on the long-term impact of these initiatives; however some evaluations have been completed (see for example Brooks, Cole, Hines, Lewis, Ohn, Pollock, Ritchie and Vincent, 2003; Anning and the National Evaluation of Sure Start, 2007; The National Evaluation of Sure Start Team, 2008). The Sure Start national evaluation team found variation in the implementation of SSLPs but found positive impacts on a range of factors. For example, the parents of three-year-old children showed less negative parenting while providing their children with a better home learning environment. Three-year-old children in SSLP areas had better social development with higher levels of positive social behaviour and independence/self-regulation than children in similar areas not having a SSLP.

There has been some criticism of SSLPs. Rutter (2007) acknowledged that the government's desire to improve outcomes for children growing up in England was to be commended, and that there was research evidence for the effectiveness of pre-school programmes, but he criticised the implementation of programmes within SSLPs and their evaluation. He argued that SSLPs differed from initiatives previously evaluated in several key respects. For example, each SSLP was left to decide what it wanted to change and how it was going to implement those changes. There was a lack of specification in how goals should be met and what sort of curriculum should be provided. There was very little piloting of programmes prior to large-scale implementation. With respect to the evaluation of the impact of the SSLPs, Rutter identified several limitations, including their diversity and the lack of random assignment of individuals or areas to different programmes. Raffo et al.

(2007) have also criticised Sure Start and other recent initiatives, saying that "These interventions have been undertaken in a piecemeal fashion and so far have had only a very partial impact in breaking the link between poverty and poor educational attainment."

Another large scale English Government initiative within the last ten years has been the establishment of Education Action Zones (EAZs) aimed at raising educational standards in disadvantaged urban and rural areas. These were local partnerships between groups of schools (both primary and secondary, in groups of not more than 20), businesses, parents and local authorities. EAZs usually ran for three years, with the possibility of extended funding for a further two years. In addition to the focus on schools, these zones received preferential treatment on funding to set up nurseries. The first group of 12 EAZs was set up in 1998, with a second round of 13 more introduced in 1999. The end total was 73 zones serving 1,444 schools covering approximately 6% of the school population of England. Some of these EAZ programmes included interventions for pre-school and school children. An evaluation of the second round of EAZs by the Office for Standards in Education (OFSTED, 2003) reported variable findings. Amongst the conclusions, it reported that "Although some success was evident, overall, the headway made by zones, and the schools in them, was too variable. In the majority of zones there was not enough deliberate and sustained attention to tackling difficult common issues" (Page 39).

In 2003, the Government published a green paper called Every Child Matters, which prompted a debate about services for children, young people and families. Following the consultation, the Government published Every Child Matters: the Next Steps, and

passed the Children Act 2004, providing legislation to support the development of integrated services to meet the needs of children from birth to age nineteen years. Their aim was to provide facilities for every child, whatever their background or circumstances, to have the support they need to be healthy, stay safe, enjoy and achieve, make a positive contribution, and achieve economic wellbeing. Like Sure Start, this initiative involved providers of education, social and health services working together to provide an integrated service.

Other smaller-scale initiatives are too numerous to mention.

This paper aims to investigate the extent to which children's cognitive development on entry to school changed over the latter part of this period. Monitoring improvements over time requires reliable assessment data, whose content remains unchanged, collected on a wide scale over an extended period. The statutory Foundation Stage Profile cannot be used for this purpose because it was not introduced until 2003, it has changed since that date and is based on teacher judgement. On the other hand, the Performance Indicators in Primary Schools (PIPS) On-entry Baseline Assessment (BLA) collects very reliable objective data which has well-established predictive validity and has remained unchanged for several years (CEM Centre 1999; Tymms, Merrell and Henderson, 2000). This paper reports the results of the PIPS BLA in England over the period of 2001 to 2008 inclusive for the same four hundred and seventy two primary schools against a range of background variables collected at pupil level. A dataset of this size and consistency over time is rare, particularly of children's cognitive development at the start of school, and as such adds to the existing studies of trends over time.

Measures and Sample

The PIPS project is one of several projects run from the Centre for Evaluation and Measurement (CEM) at Durham University (CEM, 2009), which provides schools with monitoring systems for children aged three to eighteen years. Schools (and sometimes whole districts) choose to opt into the systems and pay an annual subscription for their use. More than one million children each year are assessed. CEM provides the assessments and then marks and analyses the data for schools, and feeds back standardised scores for the attainment, attitudes and progress of their pupils. As a result, CEM holds large datasets that can be further analysed for research purposes such as this paper.

The PIPS BLA was developed by CEM and is administered within the first six weeks of a child starting compulsory education on an individual basis, taking approximately twenty minutes per child. It is a computer-delivered assessment whose content is based on areas of children's development which have been shown to be the best predictors of later success or difficulty at school (Tymms, 1999). It includes sections of vocabulary, early reading, and early mathematics, specifically:

- Picture Vocabulary – the child is asked to identify objects embedded within a picture showing a familiar scene.
- Ideas about reading – assesses concepts about print such as pointing to the start of a sentence.
- Letter identification – a fixed order of mixed upper and lower case letters.
- Word recognition and reading – this begins with multiple choice word recognition and moves on to children reading simple sentences aloud, and

finally on to children reading a text in which approximately every fifth word is a choice of three and the child has to select the correct one.

- Ideas about mathematics – assessment of understanding of the vocabulary associated with mathematical concepts such as 'biggest' and 'smallest'.
- Counting and Numerosity – the child is asked to count four objects. These disappear from the screen and then the child is asked how many objects they saw. This is repeated with seven objects.
- Sums – addition and subtraction problems presented without symbols.
- Shape identification.
- Digit identification – single, two-digits and three-digits.
- Maths problems – including sums with symbols.

The teacher works with individual pupils and the computer program presents the child with questions (orally). Depending on the type of question, the child responds either by pointing to the answer from the choice of options on the screen, or by saying the answer. The teacher records the child's response on-screen and the program selects the next question.

The assessment has high test/re-test reliability (0.98) and internal reliability (0.94), and good predictive validity, for example the correlations between the PIPS BLA and reading and maths at age 7 were 0.70 and 0.65 respectively (Tymms, Merrell and Henderson, 2000).

The sample consisted of four hundred and seventy two state primary schools in England that carried out the PIPS BLA with all of their children entering school in September every year from 2001 to 2008 inclusive. A large number of schools opt in to use the PIPS BLA each year but it is their choice of whether or not to continue year-after-year and so the sample varies over time as some schools leave the system,

either permanently or temporarily, and other schools join. The sample analysed for this paper was the total number of schools that had consistently used the PIPS BLA every year during the period in question. Prior to 2001, the content of the assessment differed slightly and so it was decided not to include data from before that year. The schools were self-selected and the extent to which they are representative of England as a whole is discussed in the next section.

The number of pupils assessed each year is shown in Table 1.

Insert Table 1 here

Additional information on the pupils' date of birth, sex, special needs and first language was recorded. Information was not collected about any specific initiatives (for example a Sure Start Local Programme) that pupils had been involved with prior to starting school.

Results

Changes in Background Variables

Firstly, the representativeness and stability of the proportion of pupils with English as an Additional Language (EAL), the sex of the pupils and the mean age at test were investigated. Comparing these variables to national norms gives an indication of the representativeness of the sample. If these characteristics changed a large amount over the period of investigation, they should be considered when interpreting the trends found in the PIPS BLA scores over time. Table 2 shows the percentage of EAL and boys, and the mean age of the pupils when they were assessed each year.

Insert Table 2 here

There was no significant difference in the percentage of males each year. A Chi Square test showed that the proportion of children with EAL varied over time to a statistically significant degree. It increased each year between 2001 and 2006 but then decreased in the following two years. The mean age at test also appeared to be stable but did in fact differ to a statistically significant extent ($p = 0.03$) over time. It varied between 4.56 and 4.66 years.

Nationally, the percentage of children with English as an Additional Language in English primary schools was 11.5% in 2005, 12.5% in 2006 (DfES, 2006) and 13.5% in 2007 (DCSF, 2007). The percentage of pupils for whom English was an additional language in the samples analysed in this paper increased over time as national trends did, but was higher than the national figures for 2005, 2006 and 2007. It should be noted it was an optional part of the assessment for schools to supply information about EAL and so therefore there was some missing data, as specified below Table 2.

Attainment on entry to school was compared to the national average to give another angle on the representativeness of the sample. The early reading, picture vocabulary and early maths PIPS scores from the total number of participating schools are standardised annually. These attainment scores are expressed as T scores with a mean of 50 and standard deviation of 10. The whole sample is checked each year to ensure that they are nationally representative by analysing school size, deprivation levels and statutory assessment outcomes therefore the national average was 50 with a standard deviation of 10. . As explained earlier, not all participating schools were included

within this study; just those who had used PIPS every year over the period in question. The mean PIPS BLA total scores of the sample of schools selected for inclusion in this study were consistently significantly lower than the national average. These are reported in Table 3.

Insert Table 3 here.

In summary, the schools in the sample for this study had a higher proportion of children with English as an additional language, and had lower on-entry baseline scores than the national average.

Changes in PIPS BLA Scores over Time

When looking at changes over time, it is necessary to look at changes in raw scores because yearly standardisations may introduce variation. Table 4 shows the mean raw scores and standard deviations from the PIPS BLA for early reading, picture vocabulary, early mathematics and the total each year between 2001 and 2008 inclusive.

Insert Table 4 Here

Looking at Table 4, the picture vocabulary and early reading mean scores were generally stable but in 2008 they were actually lower than when the data collection began in 2001. The early maths mean scores were higher in 2008 than when data collection began in 2001. One-way Analysis of Variance indicated statistically

significant differences ($p<.05$) over time for the three separate areas and the total score although in educational terms, the differences were very small. The smallest difference between two time points was for picture vocabulary, which amounted to an Effect Size of -0.07. The largest difference was for early maths, which amounted to an Effect Size of 0.11. It is concluded that children's scores at the start of school were generally stable over the period investigated prior to controlling for background variables and that although the changes were statistically significant, they were too small to be educationally significant.

Main Effects and Interactions

General Linear Models were used to analyse changes in the PIPS BLA scores over time in relation to Year[3], EAL and sex. Age at test was entered as a covariate. All two-way interactions were considered. Tables 5, 6, and 7 show the results for early reading, early maths and picture vocabulary respectively.

Insert Tables 5-7 here

Year was statistically significant for all outcomes. That is, after controlling for age at test, there were significant differences over time. Children for whom English was an additional language had significantly lower scores than children with English as their mother tongue for all outcomes.

[3] Year is used to refer to the academic year.

Summary and Discussion

This paper has presented data on the abilities of children starting compulsory education in England between the years 2001 and 2008 inclusive. The measures are good indicators of later success in reading and mathematics. The sample comprised a group of four hundred and seventy two primary schools that had carried out the same baseline assessment over the period in question. Nearly 118,000 children were assessed. The total baseline score was consistently significantly lower than the national average each year. The analysis of background variables showed that the percentage of children for whom English was an additional language was higher than the national average and increased each year, as it did nationally. The proportion of boys and girls, and the mean age at test remained stable over the period investigated.

Analysis of the data suggested that:

- The abilities of children showed a statistically significant decrease from 2001 to 2008 for early reading and picture vocabulary. However, the effect sizes of the differences were small and probably not educationally significant.
- The early maths scores rose significantly in the period studied although again the effect size was small and probably not educationally significant.

Why should the scores on the BLA have been so stable? The introduction described some of the major initiatives that had been implemented on a wide scale during the years preceding and during the period of time investigated in this study. On the one hand one might expect that these initiatives would have resulted in measurable changes, especially the introduction of a comprehensive early years curriculum for all

children attending pre-school educational settings. This would have been experienced by a high proportion of children in the sample after its introduction in 2003 and so changes could have been observed from 2004 onwards. We recognise that other areas of development such as children's personal, social and emotional development, motor development and creative development are important and these were outside the scope the present study. It is possible that these changed over the period investigated.

We do know that influencing the development of young children through early interventions is not easy. Whilst there are many positive examples of successful interventions there are also many examples of less successful initiatives (see for example Ramey and Ramey, 1998). More recently, Driessen (2004) investigated the impact of early childhood education and care in The Netherlands. He found that over the period 1996 – 2000, there were no demonstrable effects of pre-school programmes on the cognitive or non-cognitive competencies of elementary school children. Belsky (2006) noted that "whatever formal evaluations of early interventions reveal about what occurs developmentally when economically-disadvantaged children are provided with very special experimental programmes, often established for research purposes, should not automatically be equated with what transpires when far different populations of children experience community-based day care." Zigler and Styfco (2006) also noted a reduction in the efficacy of interventions when they are expanded from being delivered by experts in an optimal environment to community-based programmes.

Whilst there are limitations to the interpretations that can be made of the data presented in this paper, the analyses are important because they have investigated

children's cognitive development at the start of school in England on a large scale and using a consistent measure, which is extremely rare and adds to the large-scale studies of educational trends over time. Whilst we stress that this study does not constitute a formal evaluation of the government's initiatives, it nevertheless provides a single broad perspective on the changing profiles of children starting school in England during a time of rapid change and the picture is one of stability so far as the cognitive developmental levels in early reading, vocabulary and early maths of children starting school are concerned.

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Tables

Table 1 Number of Pupils Assessed

Academic Year	Number of Pupils
2001	15,319
2002	14,928
2003	14,815
2004	14,501
2005	14,099
2006	14,209
2007	14,761
2008	15,262

Table 2 Information about Background Variables

Academic Year	% EAL	% boys	Mean age at test
2001	9.9	51.5	4.56
2002	10.3	51.1	4.55
2003	11.5	50.7	4.55
2004	12.0	50.6	4.56
2005	13.5	51.1	4.56
2006	15.2	51.5	4.56
2007	15.0	51.4	4.55
2008	14.2	51.1	4.55

N.B. EAL data were available for 83.7% of children in the study.

Table 3 Mean Standardised PIPS BLA T Scores

Academic Year	Mean total PIPS BLA T score (SD in brackets)
2001	48.67 (9.66)
2002	48.50 (9.77)
2003	48.31 (9.43)
2004	48.34 (9.49)
2005	48.23 (9.47)
2006	48.25 (9.42)
2007	47.84 (9.41)
2008	47.59 (9.22)

Table 4 Raw Scores from PIPS BLA

	Early Reading		Early Maths		Picture Vocabulary		Total	
Academic Year	Mean (max = 170)	SD	Mean (Max = 69)	SD	Mean (Max = 23)	SD	Mean Max = 262)	SD
2001	14.32	13.90	22.71	9.21	13.66	4.48	50.69	23.64
2002	13.96	13.44	22.66	9.17	13.53	4.56	50.14	23.29
2003	13.32	13.02	22.80	9.16	13.53	5.05	49.64	23.15
2004	13.28	13.03	22.84	9.25	13.70	5.04	49.82	23.27
2005	13.20	13.07	22.38	8.79	13.52	5.04	49.10	22.88
2006	13.59	13.93	23.16	9.15	13.66	5.11	50.40	23.82
2007	13.24	13.67	23.62	9.22	13.51	5.11	50.37	23.57
2008	13.14	13.37	23.74	9.18	13.34	5.08	50.25	23.28

Table 5 General Linear Model Analysis of Early Reading

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	958649.195(a)	25	38345.968	225.614	.000
Intercept	238999.695	1	238999.695	1406.187	.000
sex	59413.125	1	59413.125	349.565	.000
EAL	141126.908	1	141126.908	830.339	.000
Year	7423.375	7	1060.482	6.239	.000
Age_at_test	593957.679	1	593957.679	3494.630	.000
sex * EAL	4230.012	1	4230.012	24.888	.000
sex * Year	1801.701	7	257.386	1.514	.157
EAL * Year	2484.370	7	354.910	2.088	.041
Error	16661470.336	98030	169.963		
Total	35325860.000	98056			
Corrected Total	17620119.531	98055			

a R Squared = .054 (Adjusted R Squared = .054)

Table 6 General Linear Model Analysis of Early Mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	868786.086(a)	25	34751.443	464.026	.000
Intercept	53333.493	1	53333.493	712.146	.000
sex	16537.739	1	16537.739	220.824	.000
EAL	304489.701	1	304489.701	4065.761	.000
Year	8537.787	7	1219.684	16.286	.000
Age_at_test	511316.918	1	511316.918	6827.464	.000
sex * EAL	6.901	1	6.901	.092	.761
sex * Year	570.878	7	81.554	1.089	.367
EAL * Year	852.635	7	121.805	1.626	.123
Error	7336864.897	97967	74.891		
Total	59660422.000	97993			
Corrected Total	8205650.984	97992			

a R Squared = .106 (Adjusted R Squared = .106)

Table 7 General Linear Model Analysis of Picture Vocabulary

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	592937.959(a)	25	23717.518	1280.720	.000
Intercept	482.187	1	482.187	26.038	.000
sex	7764.050	1	7764.050	419.250	.000
EAL	520314.727	1	520314.727	28096.418	.000
Year	1052.731	7	150.390	8.121	.000
Age_at_test	52735.847	1	52735.847	2847.677	.000
sex * EAL	68.064	1	68.064	3.675	.055
sex * Year	767.379	7	109.626	5.920	.000
EAL * Year	377.550	7	53.936	2.912	.005
Error	1816741.049	98102	18.519		
Total	20356283.000	98128			
Corrected Total	2409679.007	98127			

a R Squared = .246 (Adjusted R Squared = .246)