Department for Education

Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to age seven years

Research Report

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Executive Summary

Key points

- Attending higher quality ECEC in nursery classes, nursery schools or playgroups between ages 2 and 4 was associated with better academic results for Key Stage 1 Maths, Key Stage 1 Science and for a combined Key Stage 1 English and Maths outcome during school Year 2.

- Children from the 40% most disadvantaged families who started using at least 10 hours per week ECEC before age 2 in nursery classes / schools, playgroups or with childminders, and who went on to attend for at least 20 hours per week between age 2 and the start of school, had better outcomes on Key Stage 1 Reading, Writing and Science and on the Phonics check than children who had never attended such childcare for 10 or more hours per week.

- The amount of Early Childhood Education and Care (ECEC) that children attended between age 2 and the start of school was not associated with children's Key Stage 1 academic outcomes or the result of the school Year 1 Phonics check. Please note that only 19 children in the sample (0.5%) had no ECEC before the start of school (see Appendix C), therefore the models presented in the analyses assess the effects associated with variation in amount of ECEC, they do not assess the effect of receiving ECEC or not.

- Higher Home Learning Environment scores were associated with children performing better on all Key Stage 1 outcomes and on the Phonics check.

- Higher Permissive Parenting scores were associated with poorer child performance on the Key Stage 1 outcomes.

- Higher Parental Limit Setting scores were associated with better outcomes for Key Stage 1 Reading, Maths and Science.

- Higher Warmth in the parent / child relationship was associated with better child outcomes for KS1 Reading, Maths and Science and on the Phonics check.

- Comparisons of the findings from the earlier Effective Pre-school, Primary & Secondary Education (EPPSE) and the Study of Early Education & Development (SEED) indicate the levelling up of children's ECEC experiences across the last two decades. Here, levelling up refers to the fact that there is near universal use of ECEC now, and that there has been an increase in overall ECEC quality with a reduction in the amount of poor quality ECEC, so children's ECEC experiences across the population are now more equivalent than two decades earlier. A consequence of this levelling up of ECEC experiences is that any effects of ECEC differences upon child development are likely to be reduced.

Introduction

Several decades of research have indicated that early childhood education and care (ECEC) can have a positive effect on the educational, cognitive, behavioural and social outcomes of children, in both the short and long term, particularly if it was of good quality

(Melhuish et al., 2015; Sylva et al., 2010. From September 2004, all three- and four-year-olds in England have been entitled to some funded early education. Since September 2010 this entitlement for all three- and four-year-olds in England was for 570 hours per year (commonly taken as 15 hours per week for 38 weeks of the year). From September 2017 the entitlement was doubled to 1140 hours per year (equivalent to 30 hours per week for 38 weeks of the year) for families where parents are each earning at least the equivalent of the National Minimum Wage or Living Wage for 16 hours per week.

Research has shown that the benefits of high-quality early education exist even when it starts as young as two years of age (Sammons et al., 2002; Smith et al., 2009). In 2013 the UK Government expanded the funded early education entitlement to two-year-old children living in certain disadvantaged households in England. Specifically, from September 2013 the entitlement was introduced for two-year-olds looked after by the local authority and those from families in receipt of specified benefits, who might be regarded as the most disadvantaged. It was further extended in September 2014 to two-year-olds from low income families, two-year-olds with special needs and two-year-olds who had left care.

The Study of Early Education and Development (SEED) includes a major longitudinal study designed to provide evidence on the effectiveness of early years education and to identify any short- and longer-term benefits from this investment. The study is conducted by a consortium including the National Centre for Social Research, the University of Oxford, Action for Children and Frontier Economics. SEED aims to study children at age two, three, four, five and seven years to seek information on how variation in ECEC experience may be associated with cognitive and socio-emotional development. This report focuses on how ECEC may be related to children's development up to the end of Key Stage 1 (seven years of age), with the objectives:

1. To study the associations between the amounts of different types of ECEC that children received between the age of two and the start of school and child development at Key Stage 1.

2. To study the associations between the quality of the ECEC group settings that children have attended aged two to four and child development at Key Stage 1.

3. To consider how the age of starting formal ECEC may be associated with child development at Key Stage 1.

4. To investigate the impact of the home environment, parenting and the quality of the parent/child relationship on development at Key Stage 1.

Method

Sample

In this report, two samples of SEED children are examined:

1. The 4,879 SEED children for whom data were available from the Key Stage 1 Phonics check.

2. The 4,868 SEED children for whom data were available from the Key Stage 1 assessment.

Early Childhood Education and Care (ECEC)

In this study, ECEC settings eligible for government funding were classified as 'formal'; those not eligible for government funding were classified as 'informal'. Settings in a non-domestic setting were classified as 'group', whilst those in a domestic setting were classified as 'individual'. The following three-way classification of ECEC is used in this report:

1. **Formal group ECEC** – ECEC in a non-domestic setting and eligible for government funding (e.g., day nurseries, nursery classes or schools and playgroups).

2. **Formal individual ECEC** – ECEC in a domestic setting and eligible for government funding (i.e., childminders).

3. **Informal individual ECEC** – ECEC in a domestic setting and not eligible for government funding (e.g., relatives, friends, neighbours and nannies).

Child development measures

Phonics Screening Check

All children in government maintained schools in England are required to take a Phonics Screening Check in school year 1. Children who do not achieve the expected standard re-take the test in school year 2. Whether or not children achieved the expected standard in the Phonics Screening Check is used as an outcome measure in this report.

Key Stage 1 assessment

All children in government maintained schools in England take a series of Key Stage 1 (KS1) assessments during school year 2.

Results were available for KS1 Reading, Writing, Maths and Science. The following six outcomes measures were derived from the KS1 assessment.

1. Achieved expected level in KS1 Reading.
2. Achieved expected level in KS1 Writing.
3. Achieved expected level in KS1 Maths.
4. Achieved expected level in KS1 Science.
5. Achieved expected level in KS1 Reading, Writing and Maths.
6. Achieved expected level in all KS1 subjects.

ECEC quality measures

Researchers assessed the quality of 1,000 ECEC settings attended by the SEED children: 402 settings attended at age two, and 598 settings attended at age three.

At age two (Wave 1), setting quality was assessed using:

1. Sustained Shared Thinking and Emotional Well-being (SSTEW) scale – measuring the quality of staff / child interaction.
2. Infant and Toddler Environment Rating Scale – Revised (ITERS-R) – an overall measure of quality for under-threes (e.g., activities, interactions, routines).

At age three (Wave 2) setting quality was assessed using:

1. SSTEW – measuring the quality of staff / child interaction.
2. Early Childhood Environment Rating Scale – Revised (ECERS-R) – an overall measure of quality for over-threes (e.g., activities, interactions, routines).
3. Early Childhood Environment Rating Scale – Extended (ECERS-E) – an extension of ECERS-R focussing on aspects of educational and learning opportunities.

Home environment measures

Nine home environment measures were included in the analyses. These were derived from the SEED Wave 1, Wave 2 and Wave 3 interviews:

1. Home Learning Environment (HLE) index (learning activities in home: e.g. parents read with child, take child to library etc.)
2. Household Disorder (CHAOS scale: e.g. house is noisy, house is disorganised).
3. Parent's Psychological Distress (e.g. symptoms of depression or anxiety).
4. Limit Setting (i.e. how often parents set limits on their child's behaviour).
5. MORS Warmth (closeness in the parent/child relationship: e.g. relationship is affectionate, parent and child do things together).[1]
6. MORS Invasiveness (conflict in the parent/child relationship: e.g. parent finds child annoying).[1]
7. Authoritative parenting, characterized by high demands / high responsiveness.[2]
8. Authoritarian parenting, characterized by high demands / low responsiveness.[2]
9. Permissive parenting, characterized by low demands / high responsiveness. [2]

Where measures were available from multiple waves, the mean value was taken.

Demographic measures

Models were also controlled for demographic variables. Details are given in Chapter 2.

Results

Statistically significant effects

An effect in a statistical model is described as statistically significant if it is unlikely to have come about by chance. Statistically significance is measured using probability of the result being found by chance (p-value). By convention, results are considered to be statistically significant if the associated p-value is 5% (.05) or less. Where the associated p-value is between 5 and 10% (.10), effects are described as of borderline statistical significance. Such effects need to be regarded with some caution. However, where a pattern of effects of borderline statistical significance occur in these analyses, such results have been used to draw conclusions. This issue is discussed in more detail in Chapter 2.

[1] See Simkiss et. al. 2013.

[2] See Robinson 1995.

Is the amount and type of ECEC associated with child development?

Models of the child outcomes were fitted in terms of the amount of ECEC which children had used between age 2 and the start of school. ECEC use was considered in three categories: formal group ECEC, formal individual (childminder) ECEC and informal individual ECEC. Models were controlled for demographic and home environment covariates.

Table 1: Results of models of outcome variables in terms of the amount of ECEC used between age 2 and the start of school.

Outcome	Formal group Effect	Formal group p-value	Formal group Effect	Formal group p-value	Informal individual Effect	Informal individual p-value
KS1 Reading	1.008	0.891	1.003	0.972	0.966	0.551
KS1 Writing	1.024	0.647	1.069	0.439	1.007	0.891
KS1 Maths	1.027	0.655	0.924	0.367	0.955	0.426
KS1 Science	1.067	0.342	1.085	0.475	0.998	0.976
KS1 English / Maths	1.002	0.976	0.944	0.456	1.006	0.909
KS1 All Subjects	1.004	0.935	0.953	0.532	1.009	0.860
Phonics (pass/fail)	0.962	0.685	1.071	0.689	0.980	0.830

Sample size N = 4868.[3]

The effects reported are odds ratios showing the change in the probability of achieving the expected level corresponding to a change in ECEC usage of 10 hours per week. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less than one indicate a reduced probability of achieving the expected level.

There were no significant or borderline significant associations found between the amount of formal group ECEC, formal individual ECEC or informal individual ECEC used between age 2 and the start of school and children's Phonics and Key Stage 1 outcomes during school years 1 to 2 (see Table 1). This is partly attributable to the relative insensitivity of the binary outcomes available as compared with continuous outcome measures.[4] However, this lack of associations between amount of ECEC use between age 2 and the start of school and children's academic outcomes is consistent with the

[3] The sample size for the Phonics outcome is N = 4879.

[4] A binary measure has just two values, e.g. a pass / fail result in a test. A continuous measure has a full range of values, e.g. the score which a child achieved in a test. Analyses using continuous outcomes are more sensitive, i.e. they are better able to detect associations between the outcome and covariates which may influence the outcome measure.

results for children's Early Years Foundation Stage Profile outcomes from the SEED age 5 report. These results are substantially different from the results of the last comparable study in England, the Effective Pre-school, Primary and Secondary Education (EPPSE) project, which took place under different conditions. The possible reasons for the differences in results between the SEED and EPPSE studies are discussed in Chapter 7.

Is the quality of ECEC associated with child development?

Because of the intensive nature of the quality observational assessments, a subsample of all settings attended by children in the study was selected for this component. Because only a subsample of settings was assessed for quality, only a subgroup of the main sample of children was able to be included in the analysis of quality. At Wave 1, the quality of 402 settings attended by children at age two to three was assessed. At Wave 2, the quality of 598 settings attended by children at age three was assessed.

The settings for children aged two were assessed using:

- Sustained Shared Thinking and Emotional Well-being Scale (SSTEW).
- Infant and Toddler Environment Rating Scale – Revised (ITERS-R).

The settings for children aged three were assessed using:

- Sustained Shared Thinking and Emotional Well-being Scale (SSTEW).
- Early Childhood Environment Rating Scale – Revised (ECERS-R).
- Early Childhood Environment Rating Scale – Extended (ECERS-E).

The results of the models of the outcome variables in terms of the quality measures are shown in Table 2. Effects which are statistically significant or borderline statistically significant are shown in bold italics.

Table 2: Results of quality models; continuous quality variables.

Wave	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Wave 1 ITERS-R	0.943	0.810	0.959	0.853	1.275	0.305	1.086	0.755
Wave 1 SSTEW	0.835	0.467	0.949	0.818	1.185	0.483	0.939	0.817
Wave 1 Overall Quality	0.882	0.606	0.953	0.830	1.232	0.381	1.007	0.980
Wave 2 ECERS-R	1.633	0.018*	1.268	0.241	***1.481***	***0.055 (*)***	***1.662***	***0.020 ****
Wave 2 ECERS-E	1.146	0.523	1.028	0.892	1.249	0.298	***1.535***	***0.069 (*)***
Wave 2 SSTEW	1.198	0.399	1.074	0.733	1.201	0.393	1.307	0.241
Wave 2 Overall Quality	1.319	0.190	1.121	0.580	1.318	0.191	***1.512***	***0.067 (*)***
Wave 1 and 2 Overall Quality	1.581	0.415	1.465	0.283	***2.318***	***0.024 ****	-[1]	

Sample size N = 577 (Wave 1), = 694 (Wave 2), = 319 (Wave 1 and Wave 2).[5]

Effects are expressed as odds ratios showing the change in the probability of a positive outcome corresponding to a change of two standard deviations in the quality covariate. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = $p < 0.1$, * = $p < 0.05$,

[5] Sample sizes for the Phonics outcome are N = 580 (Wave 1), = 700 (Wave 2), = 323 (Wave 1 and Wave 2).

** = p < 0.01, *** = p < 0.001.

[1] Insufficient degrees of freedom to report model result.

Table 2 (contd.)

Wave	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Wave 1 ITERS-R	1.089	0.692	1.088	0.693	1.457	0.219
Wave 1 SSTEW	1.040	0.856	1.029	0.897	1.508	0.202
Wave 1 Overall Quality	1.064	0.773	1.058	0.795	1.489	0.201
Wave 2 ECERS-R	1.198	0.348	1.193	0.355	1.541	0.172
Wave 2 ECERS-E	1.003	0.986	1.018	0.929	1.473	0.265
Wave 2 SSTEW	1.052	0.797	1.037	0.854	1.334	0.390
Wave 2 Overall Quality	1.082	0.685	1.080	0.690	1.466	0.249
Wave 1 and 2 Overall Quality	*1.790*	*0.091 (*)*	1.666	0.136	-[1]	

[1] Non-finite coefficient estimate.

Wave 2 Quality

ECERS-R

Higher Wave 2 ECERS-R quality was associated with a higher probability of achieving the expected level in KS1 Reading, KS1 Maths (borderline significant effect) and in KS1 Science.

ECERS-E

Higher quality on the ECERS-E scale was associated with a higher probability of achieving the expected level in KS1 Science (borderline significant effect).

Wave 2 Overall Quality Measure
Higher quality on the overall Wave 2 quality measure was associated with a higher probability of achieving the expected level in KS1 Science (borderline significant effect).

Wave 1 and 2 Quality

Wave 1 and 2 overall quality
Higher quality on the overall Wave 1 and 2 quality measure was associated with a higher probability of children achieving the expected level in KS1 Maths. Higher quality on the overall Wave 1 and 2 quality measure was associated with a higher probability of children achieving the expected level in KS1 English / Maths (borderline significant effect).

Attending higher quality formal group ECEC between ages 2 and 4 was associated with better child outcomes in KS1 Maths, KS1 Science and with the combined KS1 English and Maths outcome. The beneficial effects of quality are predominantly associated with the ECERS-R scale — a measure of overall ECEC quality for settings for the over threes — or with composites of the available quality scales, with only one borderline significant effect associated with the ECERS-E quality measure, an extension of the ECERS-R scale which focusses on the specifically educational aspects of ECEC for the over threes. This suggests that the overall quality of childcare which children experience prior to starting school may be more significant for their later academic development than the specifically educational element of the childcare.

The age formal ECEC use starts

The outcome variables were modelled in terms of the age when at least 10 hours per week formal ECEC was first used combined with the mean usage of formal ECEC between age 2 and the start of school; see Table 3.

Table 3: Breakdown of sample by formal ECEC start age / usage factor.

Level Name	Age at which ten or more hours per week formal ECEC started	Mean weekly formal ECEC use between age two and start of school	All children		40% most disadvantaged		60% least disadvantaged	
			N	%	N	%	N	%
Never 10+ hours per week	Never		136	3.9	92	4.3	44	3.2
Early start / high use	0-24 months	Over 20 hpw	568	16.1	245	11.4	323	23.4
Early start / low-medium use	0-24 months	Up to 20 hpw	360	10.2	170	7.9	190	13.8
Intermediate start / high use	25-36 months	Over 20 hpw	210	6.0	141	6.6	69	5.0
Intermediate start / low-medium use	25-36 months	Up to 20 hpw	737	20.9	538	25.1	199	14.4
Late start / medium-high use	37-54 months	Over 10 hpw	854	24.2	524	24.4	330	23.9
Late start / low use	37-54 months	Up to 10 hpw	658	18.7	434	20.2	224	16.2

hpw = hours per week

This breakdown is for the sample of N = 4868 who had the KS1 outcomes. The results for the N = 4879 who had the Phonics outcome are very similar.

Because of the difference in the distribution of formal ECEC start age between the 40% most disadvantaged children and the 60% least disadvantaged children, analyses were carried out separately for these groups.

Model results are given in Table 4 (40% most disadvantaged children) and Table 5 (60% least disadvantaged children). Statistically significant and borderline statistically significant effects are shown in bold italics.

Table 4: Results of models of child outcomes in terms of formal ECEC start age / usage factor; 40% most disadvantaged children.

ECEC start age/ usage factor	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Never 10+ hours per week	Reference		Reference		Reference		Reference	
Early start / high use	***1.539***	***0.082 (*)***	***1.580***	***0.069 (*)***	1.350	0.199	***1.648***	***0.080 (*)***
Early start / low-medium use	1.197	0.517	1.275	0.393	1.357	0.269	1.147	0.669
Intermediate start / high use	1.267	0.370	1.303	0.354	1.318	0.283	1.313	0.351
Intermediate start / low-medium use	1.178	0.473	1.223	0.386	1.200	0.387	- [1]	
Late start / medium-high use	1.310	0.244	1.360	0.235	1.262	0.293	1.249	0.452
Late start / low use	1.270	0.302	1.248	0.347	1.340	0.163	1.147	0.625

Sample size N = 3179.[6]

The effect is the difference in the probability of achieving the expected level between a given group and the reference group, expressed as an odds ratio. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = $p < 0.1$, * = $p < 0.05$, ** = $p < 0.01$, *** = $p< 0.001$.

[6] The sample size for the Phonics outcome is N = 3184.

[1] Too few degrees of freedom to report model coefficient.

Table 4 (contd.)

ECEC start age/ usage factor	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Never 10+ hours per week	Reference		Reference		Reference	
Early start / high use	1.427	0.107	1.418	0.112	***2.108***	***0.052 (*)***
Early start / low-medium use	1.257	0.370	1.239	0.401	1.489	0.345
Intermediate start / high use	1.401	0.203	1.402	0.205	1.175	0.703
Intermediate start / low-medium use	1.291	0.202	1.273	0.228	1.168	0.592
Late start / medium-high use	1.356	0.159	1.350	0.168	1.552	0.181
Late start / low use	1.360	0.143	1.329	0.179	1.481	0.261

Table 5: Results of models of child outcomes in terms of formal ECEC start age / usage factor; 60% least disadvantaged children.

ECEC start age/ usage factor	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Never 10+ hours per week	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Early start / high use	1.056	0.898	1.130	0.766	1.018	0.971	1.499	0.418
Early start / low-medium use	1.388	0.450	1.390	0.447	1.131	0.802	2.019	0.197
Intermediate start / high use	0.993	0.989	0.745	0.541	0.958	0.935	1.096	0.873
Intermediate start / low-medium use	1.385	0.450	1.191	0.664	1.322	0.579	1.549	0.324
Late start / medium-high use	1.052	0.901	1.017	0.967	1.222	0.671	1.232	0.661
Late start / low use	1.044	0.916	1.167	0.710	1.040	0.931	1.409	0.473

Sample size N = 1689.[7]

The effect is the difference in the probability of achieving the expected level between a

[7] The sample size for the Phonics outcome is N = 1695.

given group and the reference group, expressed as an odds ratio. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = p < 0.1, * = p < 0.05, ** = p < 0.01, *** = p< 0.001.

Table 5 (contd.)

ECEC start age/ usage factor	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Never 10+ hours per week	Reference	Reference	Reference	Reference	Reference	Reference
Early start / high use	1.079	0.839	1.064	0.868	1.649	0.534
Early start / low-medium use	1.354	0.446	1.379	0.418	1.332	0.731
Intermediate start / high use	0.760	0.545	0.774	0.572	0.830	0.831
Intermediate start / low-medium use	1.325	0.469	1.335	0.458	0.872	0.851
Late start / medium-high use	1.120	0.755	1.129	0.739	1.013	0.985
Late start / low use	1.075	0.846	1.057	0.881	1.289	0.739

For the 40% most disadvantaged group, children in the early start / high use group had a higher probability than the reference group of achieving the expected level in KS1 Reading, KS1 Writing and KS 1 Science, and a higher probability of achieving a pass in the Phonics Screening Check (Table 4). All results were of borderline statistical significance, but do show a consistent pattern reflecting more positive outcomes for the early start / high use group amongst the 40% most disadvantaged.

That there are benefits for more disadvantaged children from an early start in formal ECEC is consistent with the results for performance in the Early Years Foundation Profile found in the SEED age 5 report.

Are variations in the home environment associated with child development?

There was strong evidence for the influence of both the home environment and the quality of the parent/child relationship on the child's cognitive and socio-emotional outcomes.

The results of models of the outcome variables in terms of the home environment covariates are shown in Table 6. Statistically significant and borderline statistically significant effects are shown in bold italics.

Table 6: Summary of the associations between home environment variables and children's outcomes during school years 1 to 2.

	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Home learning environment	1.435	<0.001***	1.427	<0.001***	1.487	<0.001***	1.460	<0.001***
Household chaos		-		-		-		-
Parent's psychological distress		-		-		-		-
Parental limit setting	1.367	<0.001***		-	1.502	<0.001***	1.433	<0.001***
Parental warmth	1.312	0.001**		-	1.303	0.002**	1.573	<0.001***
Parental invasiveness		-		-	0.790	0.030*	0.803	0.035*
Authoritarian parenting		-		-		-		-
Authoritative parenting		-		-		-		-
Permissive parenting	0.768	0.006**	0.742	0.001**	0.837	***0.038****	***0.804***	***0.045****

Sample size N = 4868.[8]

The effects are odds ratio showing the change in the probability of achieving the expected level corresponding to a two standard deviation change in the home environment covariate, controlling for all other model covariates. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less

[8] The sample size for the Phonics outcome is N = 4879.

than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = p < 0.1, * = *p* < .05, ** = *p* < .01, *** = *p* < 0.001.

Table 6 (contd.)

	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Home learning environment	***1.420***	***<0.001******	***1.405***	***<0.001******	***1.727***	***<0.001******
Household chaos		-		-		-
Parent's psychological distress		-		-		-
Parental limit setting		-		-		-
Parental warmth		-		-	***1.359***	***0.013****
Parental invasiveness		-		-		-
Authoritarian parenting		-		-		-
Authoritative parenting		-		-		-
Permissive parenting	***0.779***	***0.004****	***0.786***	***0.005****		-

Home learning environment (HLE)

Higher Home Learning Environment was associated with better performance on KS1 Reading, Writing, Maths and Science, KS1 English & Maths, KS1 All Subjects and the Phonics Screening Check.

Household CHAOS

There were no statistically significant associations between household chaos and children's outcomes during school years 1 to 2.

Parent's psychological distress

There were no significant associations between parent's psychological distress and children's outcomes during school years 1 to 2.

PCCT limit setting

Higher parental limit setting was associated with a higher probability of children achieving the expected level in KS1 Reading, Maths and Science.

MORS warmth

Higher warmth in the parent/child relationship was associated with a higher probability of children's achieving the expected level in KS1 Reading, Maths and Science. Higher levels of warmth were also associated with better performance in the Phonics Screening Check.

MORS invasiveness

Higher invasiveness in the parent/child relationship was associated with a lower probability of children's achieving the expected level in KS1 Maths and Science.

PSD authoritarian parenting

There were no statistically significant associations between authoritarian parenting and children's outcomes during school years 1 to 2.

PSD authoritative parenting

There were no statistically significant associations between authoritative parenting and children's outcomes during school years 1 to 2.

PSD permissive parenting

Higher permissive parenting was associated with poorer child outcomes on all KS1 measures.

Home environment factors, including the quality of the parent/child relationship have considerable influence on children's educational outcomes during school years 1 to 2. Given the timing of the measurements, and because an extensive number of factors were controlled for in the analyses, the relationships between home environment and child outcome are assumed to be causal.

The relative influence of home environment and demographic factors

Demographic covariates were significantly associated with all the child outcomes. The effects of demographic outcomes tended to be larger than those of the home environment measures. The largest influence on all the child outcomes analysed was mother's education, more education associated with better outcomes. Father's education was also a similar significant influence on certain child outcomes, even once mother's education was controlled for.

Girls had significantly better outcomes on the Phonics check and on all KS1 outcomes except maths. Children who were older in their school year performed better, as did children with higher birth weights. There were also benefits associated with coming from a household with higher socio-economic status, higher income and a household where

someone was working. There were negative associations with coming from a disadvantaged family and with coming from a family with three or more siblings.

The effects of home environment and demographic factors on children's academic outcomes show a fair degree of continuity between the age 6 to 7 outcomes considered here and the outcomes considered in earlier waves of the SEED study.

Conclusions

The SEED study has investigated the influence of ECEC upon children's development following a period of substantial change in the UK policy landscape for ECEC. This report focuses on children's academic outcomes in school years 1 and 2. The binary outcomes used limit the sensitivity of the analyses, which may partly account for the lack of associations between the overall amount of ECEC which children used and their academic outcome measures.

However, attending better quality ECEC was associated with better child outcomes. Additionally, an early start to formal ECEC combined with a higher amount of formal ECEC use was associated with better child outcomes for disadvantaged children only.

The home environment proved to be a powerful and consistent influence upon children's outcomes, including the home learning environment, the quality of the parent/child relationship and parental limit setting.

Children's characteristics were influential in that girls did better than boys and children's age in the school year had a substantial effect, with older children doing better. Family characteristics were also important, particularly parental education, with socio-economic status, income and being in a working household all being linked to children's development.

The overall effects for child development associated with differences in ECEC experience found in SEED are somewhat less that those reported in the earlier substantial study, the Effective Pre-school, Primary & Secondary Education (EPPSE). These differences reflect the changes in the ECEC landscape in the UK that have occurred over the last two decades. Compared with twenty years ago, now almost all children attend early childhood education, and the quality of ECEC has improved substantially (Melhuish 2016; Melhuish & Gardiner, 2019), largely through the reduction in the extent of poor quality ECEC, which was more prevalent in earlier decades. Hence, there has been a levelling up in the ECEC experiences of children across the socio-economic spectrum, with less variation in amount, or quality, of ECEC experiences across the population. This can be regarded as a "good news" story as the situation for children now is substantially better than it was at the end of the twentieth century. It is noteworthy that the policy changes leading to these benefits were driven by ground-breaking UK research, which has come to be recognised across the world.

Overall, there is much of interest to policy-makers, practitioners and parents in the results deriving from the SEED study.

Chapter 1: Background to Early Childhood Education and Care (ECEC) Policy

Introduction

Social change is proceeding at an ever increasing rate, and part of this change involves the changes to the care and education of children before they go to school. In developed countries the number of children attending non-parental childcare and education services before school entry has been increasing since the 1960s, and some preschool education or care has become the norm for most children in developed countries.

'Today's rising generation in the countries of the OECD is the first in which a majority are spending a large part of their early childhoods, not in their own families, but in some form of childcare' (UNICEF Innocenti Research Centre, 2008:3).

The terms 'day care', 'child care' and 'early childhood education and care' (ECEC) have all been used to refer to non-parental childcare and early education occurring before school. This includes childcare with relatives, childminders, and group or centre-based childcare and early education. The Organisation for Economic Co-operation and Development (OECD) and the European Commission have adopted the term 'early childhood education and care' (ECEC) in their publications to encompass all these forms of childcare and early education. Sometimes ECEC has an explicit educational component and sometimes not. However, in that all experience can potentially be educational, this distinction is not clear-cut.

ECEC has the potential to benefit families as well as children. It can enable parents to work, re-enter the labour market, undergo training to improve employability and work more hours. Thus, it can play a role in improving family income, reducing welfare dependency and poverty, and improving social mobility for families – and later for the children themselves. ECEC provision may have implications for fertility rates, with greater availability of ECEC generally tending to promote couples' decisions to have children (Rindfuss et. al. 2010); ECEC provision is also embedded in a broader context of educational and family policies (e.g., European Commission, Directorate-general for Education, Youth, Sport and Culture, 2014). Rates and type of ECEC use and the content and quality of ECEC differ by child age and socio-political context. For instance, on average across OECD countries, 70 per cent of three-year-olds, 85 per cent of four-year-olds and 95 per cent of five-year-olds were enrolled in paid ECEC of some form (or primary education) in 2014 (OECD, 2017). In England in 2018, 94 per cent of three- and four-year-olds received some government-funded ECEC (DfE, 2018), while take-up of formal ECEC for children aged zero to two in England was 40% (DfE, 2018a).

ECEC and child development

A great deal is already known about the benefits of early childhood education in terms of benefits for educational, cognitive, behavioural and social outcomes of children, both in the short and long term. There is good evidence that early education has a considerable influence on school readiness, long-term school attainment and lifelong outcomes (e.g., Melhuish, 2004; Melhuish et al., 2015; Smith et al., 2009; Sylva et al., 2004, 2010). Attending high quality ECEC helps prepare young children to be 'school ready', i.e. achieving the level of development that helps their ability to learn when they start school

(Becker, 2011), which is important as a foundation for a successful educational career and long-term life outcomes.

For provision from three years onwards, the evidence has been relatively consistent that preschool provision is beneficial to educational and social development for the whole population (e.g., Melhuish, 2004; Sylva et al., 2010). An example of the multi-national nature of positive ECEC effects was provided by an OECD (2011) report on PISA results, reporting that 15-year-olds who had attended some pre-primary education outperformed students who had not by about a year of achievement.

Studies have also indicated that there are a number of characteristics of ECEC which lead to improved outcomes. For example, the benefits are often seen to be greater for high quality provision (Melhuish et al., 2015; Sylva et al., 2004). There is also evidence that a starting age from two years of age onwards is most effective for preschool education (Sammons et al., 2002), and that the duration in months in ECEC may have a stronger influence than the number of hours per week (Sylva et al., 2004). There has also been some evidence that high levels of ECEC, particularly group care in the first two years, may elevate the risk for developing antisocial behaviour (Belsky, et al., 2007; Eryigit-Madzwamuse & Barnes, 2013). However subsequent research indicates that this may be related to high levels of poor-quality care, particularly in group care and in the first two years of life (Melhuish et al., 2015).

ECEC has also been used as an intervention strategy to improve the lives and development of specific groups, particularly children living in disadvantaged households. Children from disadvantaged family backgrounds often enter school with fewer academic skills than their more advantaged peers, and they often lag behind in their cognitive development during the later school years (Stipek & Ryan, 1997; Sylva et al., 2012). More than 40 years of research has shown that good quality preschool experiences can produce benefits for cognitive, language and social development for disadvantaged children (e.g., Ramey et al., 2000) and help prepare them for school entry (see, for example, reviews by Barnett, 1995; Brooks-Gunn, 2003; Heckman, 2006; Melhuish, 2004; Yoshikawa et al., 2013). Some evidence suggests that early education can have the greatest impact on children from disadvantaged families (e.g., Cattan et al., 2014), and may at least be of particular importance to disadvantaged children who are already behind their peers from an early age (Speight et al., 2015). Therefore, ECEC is crucial in narrowing the gap in development and attainment between groups of children. However, children from disadvantaged families are less likely to attend early years settings, even for provision that is funded by the Government (Department for Education, 2017).

ECEC interventions also boost children's confidence and social skills, which provides a better foundation for success at school, and subsequently in the workplace (Sim, 2018). Reviews of the research often infer that it is the social skills and higher motivation that lead to lower levels of special education and school failure, and to higher educational achievement in children exposed to early childhood development programmes (e.g., Oden et al., 1996). Longer-term socio-emotional outcomes may not only be driven by short-term socio-emotional benefits of ECEC, but also by the cognitive and academic outcomes. For example, studies into adulthood have indicated that educational success is likely to be followed by increased success in employment, better social integration and sometimes in reduced criminality (e.g., Barnett, 2011; Muennig, Schweinhart, Montie, & Neidell, 2009).

With regard to provision for children from three years of age onwards, disadvantaged children benefit particularly from high-quality early education provision (e.g., Muennig et al., 2009; Reynolds et al., 2011). Research also suggests that children benefit more in socially mixed groups rather than in homogeneously disadvantaged groups (Melhuish et al., 2008a). Some interventions have shown improvements in cognitive development, but such benefits may not persist throughout children's school careers. This may be because subsequent poor school experiences for disadvantaged children overcome earlier benefits from high-quality ECEC experience (Barnett, 1995; Karoly et al., 1998).

There may be geographic or regional differences in the benefits of ECEC that relate partly to regional variation in quality (Melhuish & Gardiner, 2017). A recent publication using data from the Millennium Cohort Study suggested that the number of hours per week attending ECEC contributes to regional differences in early attainment, although several factors such as ethnic composition contribute more strongly to this variation and much regional variation remains unexplained (Dunatchik et al., 2018).

Child development is affected by a range of children's experiences, and the early years can be a particularly sensitive period of development (e.g., Tierney & Nelson, 2009). ECEC is one such influence that constitutes a substantial part of young children's experiences, which can influence short and longer-term outcomes (e.g., Sylva et al., 2010). The home environment, parenting and demographic characteristics also play a role in child development. These factors may not function alone but interact with each other. Hence the potential effects of ECEC experience may be partly moderated by family factors, such as disadvantage and the Home Learning Environment (e.g., Melhuish et al., 2008a; Sammons et al., 2008).

Recent policy and ECEC in England

Since the late 1990s, policy for early childhood education and care (ECEC) in the UK has developed rapidly (Melhuish, 2016). Following the evidence from the ground-breaking Effective Pre-school, Primary and Secondary Education (EPPSE) study revealing the positive effects of ECEC upon children's development (Sylva et al., 2004), the government implemented policies to provide a free part-time early education place (12.5 hours per week for 38 weeks of the year) for every child from their third birthday until the start of school, which came into effect from September 2004. From September 2010 all three- and four-year-olds in the UK have been entitled to funded early education for 570 hours per year (commonly taken as 15 hours per week for 38 weeks of the year). In 2013 the early education offer was extended to two-year-olds looked after by the local authority and those from families in receipt of specified benefits. It was further extended in September 2014 to two-year-olds with special needs or who have left care, and two-year-olds from low-income families who were in approximately the bottom 40% of the income distribution. This measure was introduced to increase the life chances of children from disadvantaged families following EPPSE evidence (Sammons et al., 2002; Sylva et al., 2010) that ECEC could be beneficial from two years of age upwards. These policy changes were motivated both by the desire to improve early child development and school readiness and to enable and encourage parents to undertake paid employment. These developments were underpinned by further measures to raise the quality and availability of provision and to provide support for the development of the quality of the workforce. Financial support for early education has included reimbursement of early

education expenses in tax credits (currently being replaced by Universal Credit) and childcare vouchers, which were replaced by Tax Free Childcare[9] from 2017.

From September 2017 free ECEC provision for three- and four-year-old children was extended from 15 to 30 hours each week (for 38 weeks of the year). To receive the free 30 hours/week of ECEC, parents (both parents in two parent households) must be working and each earning at least the equivalent of the national minimum wage for 16 hours a week, and not earning more than £100,000 each a year, or be self-employed for 16 hours a week.[10]

It should be noted that SEED commenced before the Childcare Act 2016 and was not designed to study the 30 hours free childcare policy. When this policy was introduced in September 2017 the children within the SEED sample, who were born from September 2010 to August 2012, were too old to be eligible for the 30 hours free childcare. Therefore, the impact of the 30 hours of free childcare policy could not be addressed by this study.

Study of Early Education and Development (SEED)

The Study of Early Education and Development (SEED) is a major eight-year study commissioned by the Department for Education to explore how early education can give children the best start in life and to investigate factors that are important for the delivery of high quality ECEC provision.[11] The study is being undertaken by a consortium including the National Centre for Social Research, the University of Oxford, Action for Children and Frontier Economics.

The aim of SEED overall is to provide a robust evidence base to inform policy development to improve children's readiness for school by:

- Giving evidence of the impact of early years provision on children's outcomes and providing a basis for the longitudinal assessment of any later impact.
- Assessing the role and influence of the quality of ECEC provision on children's outcomes.
- Assessing the overall value for money of ECEC and the relative value for money associated with different types of early childhood education and care (e.g., private, voluntary, local authority) and the quality of ECEC provision.
- Exploring how the Home Learning Environment may interact with early education use in affecting children's outcomes.

To address these aims, SEED has several inter-related research strands:

- A longitudinal study that initially included 5,642 families with preschool children from the age of two years to the end of Key Stage 1 (age seven years).

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[9] See the childcare service website, available at: https://childcare-support.tax.service.gov.uk/

[10] See the Childcare Act, 2016, available at: http://www.legislation.gov.uk/ukpga/2016/5/enacted, , or https://www.gov.uk/apply-for30-hours-free-tax-free-childcare.

[11] Further information about the SEED study and reports published to date are available at http://www.seed.natcen.ac.uk/.

- Around 1,000 visits to early years group settings and to around 100 childminders to study the quality, characteristics, and process of provision.
- Case studies of good practice in early years settings.
- A value for money study involving cost data from 166 early years settings.
- Qualitative studies of childminders and of early education provision for children with special educational needs and/or disabilities (SEN/D).
- A study of experiences of the Early Years Pupil Premium (EYPP).

Chapter 2: The SEED longitudinal study: Design and methodology

Objectives of this report

This is the fourth report from the longitudinal study (Melhuish, Gardiner & Morris 2017; Melhuish & Gardiner, 2018; Melhuish & Gardiner, 2020). A strength of this report is that it uses longitudinal data from different sources: assessments for phonics in year one, and Key Stage 1 assessments in year two of primary school, reports from parents on ECEC use, demographic, parenting and home environment variables, and from direct observations of ECEC settings. This report has four main objectives:

1. To study the associations between the amount of differing types of ECEC which children receive between age two and the start of school and children's academic outcomes during primary school years 1 to 2.
2. To explore the associations between the quality of the ECEC settings which children have attended at age two to four and children's academic outcomes during primary school years 1 to 2.
3. To explore the associations between the age at which formal ECEC (e.g. nursery classes, playgroups and childminders) was first used for ten or more hours per week and children's academic outcomes during primary school years 1 to 2.
4. To investigate the associations between the home environment at age two, three and four, including the quality of the parent/child relationship, and children's academic outcomes during primary school years 1 to 2.

The remainder of this report is structured in the following way:

- Chapter 3 examines the associations between ECEC use between age two and the start of school and children's academic outcomes during school years 1 to 2, controlling for demographic, parenting and home environment variables.
- Chapter 4 examines the associations between the quality of the ECEC provision which children have attended between ages two and four and children's academic outcomes during school years 1 to 2.
- Chapter 5 examines the associations between the age at which children first used ten or more hours per week of nursery class, playgroup or childminder (formal) ECEC and children's academic outcomes during school years 1 to 2.
- Chapter 6 uses the analyses described in Chapter 3 to examine the associations of parenting and home environment variables with children's academic outcomes during school years 1 to 2.
- Chapter 7 draws the findings of the report together and discusses the results in relation to other UK and international research.

An overview of the SEED longitudinal study

Research objectives

The SEED study uses a longitudinal, multi-cohort sample survey research design. It is designed to meet several related objectives:

1. To explore the impact on take-up of early education following the introduction of the policy of free early education for disadvantaged two-year-olds, in the year following its introduction.[12]
2. To study factors affecting children's development and behaviour during the early years. The focus is on the possible effects of ECEC, in particular ECEC between age two and the start of school, on cognitive, socio-emotional and educational development. Other factors explored are parenting (Home Learning Environment, household disorder, parental distress, parent/child relationship and Limit Setting, parenting style), and demographics.
3. To study the impact of the quality of the ECEC settings that children attend on their cognitive, socio-emotional and educational development.

Sample selection

A three-stage clustered sample design was implemented, with sample members selected from Child Benefit records (Speight et al. 2015). Initially, postcode districts were designated primary sampling units (PSUs). At the second stage, groups of postal sectors within each PSU were designated Secondary Sampling Units (SSUs). Finally, eligible families with children of the relevant age were selected for interview within each SSU. This approach was designed to generate a clustered sample of children and a sample of ECEC settings within the SSUs that the sampled children were likely to use.

The sample was selected so that children were chosen from three groups varying in level of disadvantage to match as closely as possible the policy eligibility criteria:

1. Most disadvantaged 20% who had a parent in receipt of one of:
    - Income-based Jobseeker's Allowance (JSA-IB);
    - Income-related Employment Support Allowance (ESA-IR);
    - Income Support (IS);
    - Guaranteed element of the State Pension Credit (PC with Guarantee Credit);
    - Child Tax Credit only (not in receipt of an accompanying Working Tax Credit award) with household gross earnings of less than £16,190.

2. Moderately disadvantaged 20%-40% who had a parent in receipt of Working Tax Credits with household gross earnings of less than £16,190.

3. Least disadvantaged 60% who had parents not in receipt of any of the qualifying benefits or tax credits.

[12] The results can be found in the earlier report "Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to Age Three, July 2017". https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/627098/SEED_ECEC_impact_at_age_3.pdf.

The sampling frame ensured that families from all levels of disadvantage were included in the study. By design, the disadvantaged and moderately disadvantage groups were over-represented in the sample.

Longitudinal study

The study was designed to collect information from families at four time points:

- Wave 1 (baseline) when the target child was about two years old.
- Wave 2 when the child was about three years old.
- Wave 3 when the child was about four years old.
- Wave 4 when the child was about five years old.

These data were matched with child Phonics scores (age 6) and Key stage 1 scores (age 7) from the National Pupil Database (NPD) as described below.

ECEC use

ECEC in use in England during the SEED study was of various types including:

1. Childminder
2. Nursery school
3. Nursery class attached to a primary/infant school
4. Private day nursery
5. Local Authority day nursery
6. Pre-school or playgroup
7. SEN day school, nursery or unit
8. Relative, friend or neighbour
9. Nanny or au pair
10. Other early education

Children in SEED may have attended any form of ECEC, although only the first seven were eligible for government funding. In the classification for this report, settings eligible for government funding are referred to as ‘formal’. Settings classified as ‘group’ based involve groups of children in a non-domestic setting, while those classified as ‘individual’ were in a domestic (i.e. home) setting.

A three-way classification of ECEC is used for this report:

1. “Formal group” ECEC in a non-domestic setting and eligible for government funding (e.g. day nurseries, nursery classes or schools and playgroups).

2. “Formal individual” ECEC in a domestic setting and eligible for government funding (i.e. childminders).

3. “Informal individual” ECEC in a domestic setting and not eligible for government funding (e.g. relatives, friends, neighbours or nannies).[13]

[13] The DfE Survey of Parents indicates that grandparents are by far the largest informal provider of ECEC in England (DfE, 2019).

Measures

Home Environment measures

Nine home environment measures were included in the analyses. Where home environment measures were available from more than one wave of the study, the mean value of the variable was taken over all available waves.

Averaged across the Wave 1, Wave 2 and Wave 3 interviews:

1. Home Learning Environment (HLE) index, i.e. home activities that allow learning opportunities for the child; e.g., child read to, taken to library, painting/drawing, play with letters/numbers, songs/rhymes (Melhuish et al., 2001; 2008a).

Averaged across the Wave 1 and Wave 2 interviews:

2. Household Disorder (CHAOS scale including confusion, hubbub and disorder scale), adapted from Matheny et al. 1995 by NESS (2005) and Melhuish et al. (2008b).

3. Parent's Psychological Distress (using the Kessler scale) e.g. symptoms of depression or anxiety.

4. Limit Setting (i.e. how often parents set limits on their child's behaviour such as time out or telling off).

From the Wave 2 interview:

5. Mothers Object Relations Scales (MORS) Warmth (a measure of closeness in the parent/child relationship e.g. relationship with affection, doing things together).[14]

6. MORS Invasiveness (a measure of conflict in the parent/child relationship e.g. regarding child as demanding of attention, feeling annoyance toward child).[14]

From the Wave 3 interview:

7. Parenting Styles and Dimensions (PSD) authoritative parenting, a parenting style characterized by high demands and high responsiveness.[15]

8. PSD authoritarian parenting, a parenting style characterized by high demands and low responsiveness.[15]

9. PSD permissive parenting, a parenting style characterized by low demands and high responsiveness.[15]

[14] See Simkiss et. al. 2013.

[15] See Robinson 1995.

Demographic measures

These measures were assessed at the Wave 1, Wave 2 and Wave 3 interviews carried out with parents when the children were aged two, three and four, respectively.

1. Child's month of birth / age in school year.
2. Child's gender.
3. Child's ethnic group.
4. Child's birth weight.
5. Maternal age at birth of child.
6. Number of siblings living in the same household as child.
7. Whether child was living in a couple or lone parent household.
8. Whether child was living in a workless or working household.
9. Household income.
10. Area Deprivation (Index of Multiple Deprivation, IMD).[16]
11. SEED disadvantage group (most disadvantaged, moderately disadvantaged, least disadvantaged) according to household income and benefits at baseline.
12. Type of accommodation tenure (renting / owner occupier).
13. Mother's highest academic qualification.
14. Father's highest academic qualification.
15. Highest parental socio-economic status.

Where demographic measures varied over time, the Wave 2 values were used.

Settings quality measures

The quality of 1000 ECEC settings was assessed though half day observations by trained observers, which took place in 402 settings that children had attended at age two (Wave 1), and 598 settings that children had attended at age three (Wave 2).

At Wave 1, settings were assessed using the SSTEW and ITERS-R scales. At Wave 2, settings were assessed using the SSTEW, ECERS-R and ECERS-E scales.[17]

The Sustained Shared Thinking and Emotional Well-being scale (SSTEW)[18] focuses on the quality of interactions between staff and children, and was used in the SEED study to assess settings (both for under-threes and over-threes) across five domains:

I. Building Trust, Confidence and Independence
II. Supporting and Extending Language and Communication
III. Supporting Emotional Well-being
IV. Supporting Learning and Critical Thinking
V. Assessing Learning and Language

[16] A measure which ranks every small area (average 1,500 residents) in England from most to least deprived (based on income deprivation, employment deprivation, education, skills and training deprivation, health deprivation and disability, crime, barriers to housing and services, living environment deprivation).

[17] More detail on these measures is available in the SEED Study of Quality of Early Years Provision in England (Melhuish & Gardiner, 2017).

[18] For more information on this scale see: Siraj, Kingston & Melhuish, 2015.

The Infant and Toddler Environment Rating Scale – Revised (ITERS-R)[19] is an overall measure of quality for the under-threes, and assesses settings across six domains:

I. Space and Furnishings
II. Personal Care Routines
III. Listening and Talking
IV. Activities
V. Interaction
VI. Program Structure

The Early Childhood Environment Rating Scale - Revised (ECERS-R)[20] is an overall measure of quality for over-threes, and was used to assess settings across five domains:

I. Personal Care Routines
II. Language Reasoning
III. Activities
IV. Interaction
V. Programme Structure

The Extension to the Early Childhood Environment Rating Scale (ECERS-E)[21] focus on the educational aspects of experience for the over-threes, and was used in the SEED study to assess settings for the over-threes across 3 domains:

I. Literacy
II. Mathematics
III. Diversity

Because only a subsample of settings attended by the SEED children was assessed for quality, only a subgroup of the main sample of children was able to be included in analysis of quality; see Chapter 4.

Child outcome - Phonics Screening Check

All children in government maintained schools in England are required to take a Phonics Screening Check in school year 1. Children who do not achieve the expected standard re-take the test in school year 2.

The Phonics assessment is scored from 0 to 40. The pass mark is 32. A binary outcome measure was derived as follows:

- If the child passed on the first or second attempt = 1
- Otherwise = 0

The Phonics outcome was available for 4879 children.

[19] Harms, Cryer & Clifford, 2006.

[20] Harms, Cryer & Clifford, 2005.

[21] Sylva, Siraj-Blatchford & Taggart, 2011.

Child outcome - Key Stage 1 assessment

All children in government maintained schools in England take a series of Key Stage 1 (KS1) assessments during school year 2.

Results were available for KS1 Reading, Writing, Maths and Science. The results for Reading, Writing and Maths were three-level: “working towards expected level” / “working at expected level” / “working at expected level with greater depth”. The results for Science were two-level: “working towards expected level” / “working at expected level”.

Following discussion with the DfE on the requirements for this report, the following seven outcomes were derived from the KS1 data.

KS1 Reading

Binary outcome:

- Working towards expected level = 0
- Working at expected level / working at expected level with greater depth = 1

KS1 Writing

Binary outcome:

- Working towards expected level = 0
- Working at expected level / working at expected level with greater depth = 1

KS1 Maths

Binary outcome:

- Working towards expected level = 0
- Working at expected level / working at expected level with greater depth = 1

KS1 Science

Binary outcome:

- Working towards expected level = 0
- Working at expected level = 1

KS1 English / Maths

Binary outcome:

- = 1, if KS1 Reading = 1, KS1 Writing = 1 and KS1 Maths = 1.
- = 0, otherwise.

KS1 All Subjects

Binary outcome:

- = 1, if KS1 Reading = 1, KS1 Writing = 1, KS1 Maths = 1 and KS1 Science = 1.
- = 0, otherwise.

Key Stage 1 results were available for 4868 children.

Choice of statistical models

Logistic regression

The analyses use regression modelling of children's Phonics and Key Stage 1 outcomes. These outcomes are modelled in terms of some aspect of children's ECEC usage up to the start of school (amount, type, timing or quality). As all outcome variables are binary, logistic regression models are used. Results are expressed as odds ratios.

Clustering

The families in the SEED study were selected in such a way that they are highly geographically clustered. In order to model the data accurately, the effects of this clustering must be controlled for in the statistical models. This was done using regression models which model the variation due to each level of clustering using random effects.[22]

Weighting

Sampling weights were not used in the regression models; this is standard practice for regression models of cohort data (Hansen 2012).

Missing data and multiple imputation

Children in the SEED study have incomplete data for two reasons. Firstly, some children in the original sample were lost to follow up and do not have data from later waves of the study; see Table 7.

Table 7: Number of children with data from each wave of the SEED study.

Wave	Number of children	Percentage of original sample
Wave 1	5642	100.0%
Wave 2	4583	81.2%
Wave 3	3930	69.7%
Wave 4	3218	57.0%

Secondly, children in the study may have missing data on a particular variable (so called "item missing data"). Both types of missingness can be corrected for using multiple imputation. This approach avoids the potential bias which may result from analysing only those children with complete data.[23]

The analyses in this report use multiple imputation to control for missing data in the covariates. The imputation model included all outcome variables, home environment

[22] These statistical models are called mixed-effects regression models.

[23] This issue of missing data and bias is discussed further in Appendix A.

variables, demographic covariates and ECEC usage data. Ten imputed data sets were generated. All statistical models were fitted to each of the imputed data sets and the results were combined. The numbers of children for whom data for ECEC usage between age 2 and the start of school was wholly or partially imputed are shown in Table 8.

Table 8: Numbers of children with complete and partially complete ECEC usage data between age 2 and the start of school.

	KS1 outcomes N	KS1 outcomes %	Phonics check N	Phonics check %
Children with complete ECEC data aged 2 to start of school	3523	72.4	3526	72.3
Children with partial ECEC data aged 2 to start of school	538	11.1	546	11.2
Children with imputed ECEC data aged 2 to start of school	807	16.6	807	16.5

Using multiple imputation allows all children with outcome data available to be included in the analyses; 4868 children for the Key Stage 1 outcomes and 4879 children for the phonics check.

Model interpretation

Statistical significance

In addition to the systematic relationships between the variables measured, the data also contains random variation. For this reason, the confidence that can be placed on the effects estimated varies according to the sample size, the size of the effects and the amount of random “noise” in the data. In order to draw firm conclusions, it is necessary to be confident that a particular effect did not arise by chance. When this is the case, it can be said that an effect is statistically significant. That is, whilst there is always uncertainty as to the exact value of an effect, one can be sufficiently confident that a particular effect is not due to chance alone.

Statistical significance is assessed using p-values. The p-value gives the proportion of the time that an association of the strength observed would be expected to occur by chance alone. So if an effect has a p-value of 0.01 (or 1%), this means that if there is no true relationship between the outcome variable (e.g. child’s test score) and the covariate (e.g., amount of ECEC used) then an effect of this strength would only be observed by chance 1 in 100 times. This is unlikely, so we would conclude that the observed effect is due to a real association between the child’s outcome and the ECEC covariate.

Conventionally, effects are considered to be statistically significant if the p-value is 0.05 (5%) or less. Effects with a p-value of 0.05 to 0.1 (5% to 10%) are sometimes described

as “borderline significant”. These effects are likely to be real on the balance of probabilities but should be regarded with caution.

In previous SEED impact reports, only results which were significant at the 5% level have been considered. In this report, borderline significant results will also be discussed, but only where they form part of a pattern of similar results. There are two reasons for this change:

1. In a longitudinal study, the reduction of the sample size over time due to drop out, or other factors, may result in noteworthy associations, which would have been significant at the 5% level in the full sample, reaching only borderline statistical significance for the reduced sample.

2. Some of the analyses in this report exhibit a pattern of borderline significant results (namely the quality models in Chapter 4 and the models of ECEC start age in Chapter 5). Such patterns of borderline significant results did not occur in the analyses for the earlier SEED impact reports.

Note that conclusions will not be based on an isolated borderline significant result, but will require support from other findings.

Causality

Although descriptions of statistical models often speak of ‘effects’, this is potentially misleading, since establishing that there is a statistically significant association between an outcome variable and a covariate does not in itself prove that there is a causal link between the two. There may be causation, in either direction or in both, and there may also be “confounding”, in which both covariate and outcome are linked with some other causal factor that has not been observed. This issue is discussed further in the Technical Annexe to the SEED age 5 report.[24]

Because of the timing of the measurements and because an extensive range of factors was controlled for in the analyses, the relationships between ECEC use and child outcomes and the relationships between home environment variables and child outcomes are generally assumed to be causal. However, this assumption should be subject to critical consideration throughout.

[24] See (Melhuish and Gardiner, 2020a).

Chapter 3: Models of outcomes in terms of the amount of ECEC used

Key points

- The overall amount of ECEC which children attended between age 2 and the start of school was not associated with children's Phonics and KS1 outcomes. Please note that only 19 children in the sample (0.5%) had no ECEC before the start of school (see Appendix C), therefore the models presented in the analyses assess the effects associated with variation in amount of ECEC, they do not assess the effect of receiving ECEC or not.

Introduction

This chapter considers the relationship between the amount of ECEC used between age two and the start of school and children's academic outcomes during school years 1 to 2. These analyses examine the quantity of the ECEC that children receive. The relationship between child outcomes and the quality of formal group ECEC received is discussed in Chapter 4. The effect of the age at which formal group ECEC was first used is considered in Chapter 5.

Method

The analyses were focused on the association between the amount of ECEC of differing types used by children between age two and the start of school and children's outcomes during school years 1 to 2. Partly because legislation is particularly focussed on ECEC from age two upwards and also because there was a high correlation between amount of ECEC used from aged one to two and amount of ECEC used from age two upwards, these analysis models did not control for earlier ECEC use.[25] This high correlation indicates considerable continuity of ECEC use over time.

Child outcomes were analysed in terms of the amount (mean hours per week) of ECEC used in three categories: formal group ECEC, formal individual ECEC (with childminders) and informal individual ECEC.

The ECEC covariates were modelled as continuous covariates. Note that only 19 children (0.5%) had no ECEC before the start of school (see Appendix C). So essentially the models are assessing effects associated with variations in amount of ECEC where virtually the total sample is receiving some ECEC. The model results are odds ratios, giving the effect of a 10 hour per week change in the ECEC covariate on the probability of a child achieving the expected level on a given outcome. This effect is assumed to be uniform: i.e. the effect of moving from no ECEC to 10 hours per week is assumed to be the same as the effect of moving from 10 hours per week ECEC to 20 hours per week,

[25] Because of the high correlation between ECEC use aged one to two and ECEC use between age two and the start of school, a model including both sets of covariates would be subject to multicollinearity, making model interpretation difficult.

and so on.[26] Results from previous SEED reports have shown this assumption of linearity of the effect ECEC use on child outcomes to be approximately correct.

All models were controlled for nine home environment measures and fifteen demographic measures; further details of these measures are given in Chapter 2.

Results

Model results are given in Table 9.

Table 9: Results of models of outcome variables in terms of the amount of ECEC used between age 2 and the start of school.

Outcome	Formal group Effect	Formal group p-value	Formal individual Effect	Formal individual p-value	Informal individual Effect	Informal individual p-value
KS1 Reading	1.008	0.891	1.003	0.972	0.966	0.551
KS1 Writing	1.024	0.647	1.069	0.439	1.007	0.891
KS1 Maths	1.027	0.655	0.924	0.367	0.955	0.426
KS1 Science	1.067	0.342	1.085	0.475	0.998	0.976
KS1 English / Maths	1.002	0.976	0.944	0.456	1.006	0.909
KS1 All Subjects	1.004	0.935	0.953	0.532	1.009	0.860
Phonics (pass/fail)	0.962	0.685	1.071	0.689	0.980	0.830

Sample size N = 4868.[27]

The effects reported are odds ratios showing the change in the probability of achieving the expected level corresponding to a change in ECEC usage of 10 hours per week. Odds ratios greater than one indicate an increased probability of achieving the expected

[26] More technically, there is assumed to be a linear relationship between the ECEC covariates and the log odds ratio of a child achieving the expected level on a given outcome.

[27] The sample size for the Phonics outcome is N = 4879.

level; odds ratios less than one indicate a reduced probability of achieving the expected level.

There were no statistically significant associations between the quantity of ECEC children used between age 2 and the start of school and children's academic outcomes during school years 1 to 2.

These findings are similar to those from the SEED age 5 report, where no statistically significant associations were found between children's Early Year Foundation Stage Profile (EYFSP) outcomes, which are based on teacher ratings, and the amount of ECEC which children used between age 2 and the start of school. In both cases this absence of associations is likely to be partly due to the outcome data being binary (i.e. pass / fail). These outcomes are less sensitive than continuous outcome measures, such as the BAS ability scales used at age 5; for these age 5 measures there was some association with the quantity of ECEC which children had used.[28]

At age 5 with the EYFSP outcomes, the age at which children had started using formal ECEC was a better predictor of child outcomes than the amount of ECEC used between age 2 and the start of school. Analyses of the Key Stage 1 outcomes and the Phonics check in terms of formal ECEC start age are considered in Chapter 5.

Further analyses

In the age 5 SEED report, the following further analyses were performed:

1. Analysis by specific levels of ECEC use.
2. Testing for curvilinear relationships between outcomes and ECEC use.
3. Investigating whether ECEC use interacts with:
    a. SEED disadvantage group.
    b. Home Learning Environment.

These analyses were only carried out where significant associations were found between the quantity of ECEC used and the outcome variables. Since no such associations were found for the age 7 outcomes, these further analyses were not performed.[29]

Chapter conclusions

There were no significant associations found between the amount of formal group ECEC, formal individual ECEC or informal individual ECEC used between age 2 and the start of school and children's Phonics or Key Stage 1 outcomes during school years 1 to 2. This is probably partly attributable to the relative insensitivity of the binary outcomes available here as compared with continuous outcome measures. However, this failure to find associations between children's ECEC use between age 2 and the start of school and children's academic outcomes is consistent with the results for children's EYFSP results

[28] See (Melhuish and Gardiner, 2020).

[29] The reason why these further analyses are performed only when significant effects are found in the primary analyses is that this approach avoids carrying out multiple parallel statistical tests, which would lead to an increase in the Type I error rate, i.e. an increase in the risk of findings which are due to chance alone. Carrying out such "post hoc" analyses only where significant results are found in the primary analyses avoids this problem.

from the SEED age 5 report. For these age 5 outcomes the age when children started attending formal group ECEC was found to be a more significant predictor of children's performance.

Chapter 4: Models of outcomes in terms of the quality of formal group ECEC used

Key points

- Attending higher quality formal group ECEC between ages 2 and 4 was associated with better child outcomes for KS1 Maths, KS1 Science and for the combined KS1 English and Maths outcome.

Introduction

The analyses presented in this chapter examine the potential effects of the quality of formal group ECEC that children have attended on their outcomes during school years 1 to 2. The sample size for the quality analyses was smaller than for the analyses presented in Chapters 3, 5 and 6. More detail on the measures collected in the quality study is available in the SEED quality report (Melhuish & Gardiner, 2017).

Because of the intensive nature of the quality assessments, a subsample of settings attended by children in the study was selected for quality assessments. Because only a subsample of settings was assessed for quality, only a subgroup of the main sample of children was able to be included in the analysis of quality (see Table 10). At Wave 1, the quality of 402 settings attended by children at age two to three was assessed. At Wave 2, the quality of 598 settings attended by children at age three was assessed.
The settings for children aged two were assessed using:

- Sustained Shared Thinking and Emotional Well-being Scale (SSTEW).
- Infant and Toddler Environment Rating Scale – Revised (ITERS-R).

The settings for children aged three were assessed using:

- Sustained Shared Thinking and Emotional Well-being Scale (SSTEW).
- Early Childhood Environment Rating Scale – Revised (ECERS-R).
- Early Childhood Environment Rating Scale – Extended (ECERS-E).

Further details of these measures are given in Chapter 2.

Method

Some children had quality data available from SEED Wave 1, some had quality data available from SEED Wave 2 and some children had quality data available from SEED Waves 1 and 2.

1. For children with quality data from Wave 1, the quality of the settings which children had attended at age two was assessed using three different measures:
    a. Sustained Shared Thinking and Emotional Well-being Scale (SSTEW).
    b. Infant and Toddler Environment Rating Scale – Revised (ITERS-R).
    c. A composite measure of overall quality.[30]

[30] This was the mean of the SSTEW and ITERS-R measures.

2. For children with quality data from Wave 2, the quality of the settings which children had attended at age three was assessed using four different measures:
    a. Sustained Shared Thinking and Emotional Well-being Scale (SSTEW).
    b. Early Childhood Environment Rating Scale – Revised (ECERS-R).
    c. Early Childhood Environment Rating Scale – Extended (ECERS-E).
    d. A composite measure of overall quality.[31]

3. For children with quality data from Waves 1 and 2, a composite measure of the overall quality of the settings which children had attended at age two and at age three was derived.[32]

In order for there to be a realistic expectation that the quality of settings which children had attended would have an impact on their outcomes, it was necessary that children had a significant level of exposure to the settings. In order to meet this requirement, the sample was restricted to children who had a mean level of formal group ECEC use aged two to four of at least 10 hours per week.

The numbers of children in the quality models are shown in Table 10.

Table 10: Numbers of children with quality data who also had a mean of at least 10 hours per week formal group ECEC between ages 2 and 4.

Children with quality data from:	KS1 outcomes	Phonics check
Wave 1	577	580
Wave 2	694	700
Waves 1 and 2	319	323

The quality variables were modelled as continuous covariates. The model results are odds ratios, giving the effect of a change of two standard deviations in the quality covariate on the probability of a child achieving the expected level on a given outcome. This is equivalent to comparing the effect associated with the difference between one standard deviation below the mean with one standard deviation above the mean, i.e. comparing the low with high scores for the covariate. The effect of the quality variables on the outcome measures is assumed to be approximately linear.[33]

The outcome variables were modelled in terms of each of the continuous quality measures. Models were controlled for ECEC use between age two and the start of school (formal group / formal individual / informal individual) and for home environment and demographic covariates.

[31] This was extracted from the SSTEW, ECERS-R and ECERS-E measurements using factor analysis. See Appendix B.

[32] This was extracted from the SSTEW and ITERS-R measures from Wave 1 and the SSTEW, ECERS-R and ECERS-E measurements from Wave 2 using factor analysis. See Appendix B.

[33] More technically, it is assumed that there is a linear relationship between the quality covariate and the log odds ratio of a child achieving the expected level on a given outcome.

Results

The results of the quality models are shown in Table 11. Effects that are statistically significant ($p < 0.05$) or borderline statistically significant ($p < 0.1$) are shown in bold italics.

Table 11: Results of quality models; continuous quality variables.

Wave	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Wave 1 ITERS-R	0.943	0.810	0.959	0.853	1.275	0.305	1.086	0.755
Wave 1 SSTEW	0.835	0.467	0.949	0.818	1.185	0.483	0.939	0.817
Wave 1 Overall Quality	0.882	0.606	0.953	0.830	1.232	0.381	1.007	0.980
Wave 2 ECERS-R	***1.633***	***0.018****	1.268	0.241	***1.481***	***0.055 (*)***	***1.662***	***0.020 ****
Wave 2 ECERS-E	1.146	0.523	1.028	0.892	1.249	0.298	***1.535***	***0.069 (*)***
Wave 2 SSTEW	1.198	0.399	1.074	0.733	1.201	0.393	1.307	0.241
Wave 2 Overall Quality	1.319	0.190	1.121	0.580	1.318	0.191	***1.512***	***0.067 (*)***
Wave 1 and 2 Overall Quality	1.581	0.415	1.465	0.283	***2.318***	***0.024 ****	-[1]	

Sample size N = 577 (Wave 1), = 694 (Wave 2), = 319 (Wave 1 and Wave 2).[34]

Effects are odds ratios showing the change in the probability of a positive outcome

[34] Sample sizes for the Phonics outcome are N = 580 (Wave 1), = 700 (Wave 2), = 323 (Wave 1 and Wave 2).

corresponding to a change of two standard deviations in the quality covariate. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = p < 0.1, * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

[1] Insufficient degrees of freedom to report model result.

Table 11 (contd.)

Wave	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Wave 1 ITERS-R	1.089	0.692	1.088	0.693	1.457	0.219
Wave 1 SSTEW	1.040	0.856	1.029	0.897	1.508	0.202
Wave 1 Overall Quality	1.064	0.773	1.058	0.795	1.489	0.201
Wave 2 ECERS-R	1.198	0.348	1.193	0.355	1.541	0.172
Wave 2 ECERS-E	1.003	0.986	1.018	0.929	1.473	0.265
Wave 2 SSTEW	1.052	0.797	1.037	0.854	1.334	0.390
Wave 2 Overall Quality	1.082	0.685	1.080	0.690	1.466	0.249
Wave 1 and 2 Overall Quality	***1.790***	***0.091 (*)***	1.666	0.136	-[1]	

[1] Non-finite coefficient estimate.

Wave 1 Quality

There were no significant effects of Wave 1 quality on the outcome variables.

Wave 2 Quality

ECERS-R
Higher levels of Wave 2 ECERS-R quality were associated with an increased probability of achieving the expected level in KS1 Reading, KS1 Maths (borderline significant effect) and in KS1 Science.

ECERS-E
Higher quality on the ECERS-E scale were associated with a higher probability of achieving the expected level in KS1 Science (borderline significant effect).

Wave 2 Overall Quality Measure
Higher quality on the overall Wave 2 quality measure were associated with a higher probability of achieving the expected level in KS1 Science (borderline significant effect).

Wave 1 and 2 Quality

Wave 1 and 2 overall quality
Higher quality on the overall Wave 1 and 2 quality measure was associated with a higher probability of children achieving the expected level in KS1 Maths. Higher quality on the overall Wave 1 and 2 quality measure was also associated with a higher probability of children achieving the expected level in KS1 English / Maths (borderline significant effect).

Chapter conclusions

Attending higher quality formal group ECEC between ages 2 and 4 is associated with better child outcomes in KS1 Maths, KS1 Science and with the combined KS1 English and Maths outcome. The Phonics check was not associated with ECEC quality.

While there is consistency in the pattern of results, a number of the effects found are of only borderline statistical significance. This is likely to be due to the relatively small sample size available for the quality analysis. Taken together, the significant and borderline significant effects found over several child outcomes gives good evidence for a causal association between attending higher quality formal group ECEC between ages 2 and 4 and better child academic outcomes during school years 1 to 2.

The beneficial effects of quality are predominantly associated with the ECERS-R scale — a measure of overall ECEC quality for settings for the over threes — or with composites of the available quality scales for the over threes, with only one borderline significant effect associated with the ECERS-E quality measure, an extension of the ECERS-R scale that focusses on the specifically educational aspects of ECEC for the over threes. This suggests that the overall quality of childcare that children experience prior to starting school may be more significant for their later academic development than the specifically educational element of the childcare.

Chapter 5: Models of outcomes in terms of the timing of formal ECEC use

Key points

- Children from the 40% most disadvantaged families who first used 10 or more hours per week formal ECEC before age two, and who used a mean of greater than 20 hours per week formal ECEC between age 2 and the start of school, had better outcomes on KS1 Reading, Writing and Science and on the Phonics check than children who had never used 10 or more hours per week formal ECEC.

- No such effect was found for the 60% least disadvantaged children.

Analysis in terms of the age at which formal ECEC use started

This analysis focuses on the possible effects of the age at which children first used formal ECEC to a significant extent. There is a considerable correlation between the age at which formal ECEC was first used for ten or more hours per week and the amount of formal ECEC used between age two and the start of school. For this reason, a model including the age at which formal ECEC was first used for ten or more hours per week and the amount of formal ECEC used between age two and the start of school might have problems with fit and would also be difficult to interpret. This problem can be avoided by analysing the outcome variables in terms of a single factor that combines the age at which formal ECEC was first used for ten or more hours per week with the amount of formal ECEC used between age two and the start of school.

Method

The start age / usage factor used is summarised in Table 12. This follows the method of the previous SEED age 5 report.[35] Because of the difference in the distribution of formal ECEC start age between the 40% most disadvantaged children and the 60% least disadvantaged children, analysis was carried out separately for these groups.

[35] See (Melhuish and Gardiner, 2020).

Table 12: Breakdown of sample by formal ECEC start age / usage factor.

Level name	Age at which ten or more hours per week formal ECEC started	Mean weekly formal ECEC use between age two and start of school	All children		40% most disadvantaged		60% least disadvantaged	
			N	%	N	%	N	%
Never 10+ hours per week	Never		136	3.9	92	4.3	44	3.2
Early start / high use	0-24 months	Over 20 hpw	568	16.1	245	11.4	323	23.4
Early start / low-medium use	0-24 months	Up to 20 hpw	360	10.2	170	7.9	190	13.8
Intermediate start / high use	25-36 months	Over 20 hpw	210	6.0	141	6.6	69	5.0
Intermediate start / low-medium use	25-36 months	Up to 20 hpw	737	20.9	538	25.1	199	14.4
Late start / medium-high use	37-54 months	Over 10 hpw	854	24.2	524	24.4	330	23.9
Late start / low use	37-54 months	Up to 10 hpw	658	18.7	434	20.2	224	16.2

hpw = hours per week

This breakdown is for the sample of N = 4868 who had the KS1 outcomes. The results for the N = 4879 who had the Phonics outcome are very similar.

Models of the outcome variables were fitted in terms of this factor combining age formal ECEC use started and the amount of formal ECEC used between age two and the start of school. Models were fitted separately for children from the 40% most disadvantaged families and children from the 60% least disadvantaged families. Models controlled for informal individual ECEC use between age two and start of school and demographic and home environment covariates. The reference level for the combined factor was the group that never used ten or more hours per week formal ECEC.

Results

Results are given in Table 13 (40% most disadvantaged children) and Table 14 (60% least disadvantaged children). Statistically significant and borderline statistical significant results are shown in bold italics.

Table 13: Results of models of child outcomes in terms of formal ECEC start age / usage factor; 40% most disadvantaged children.

ECEC start and usage	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Never 10+ hours per week	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Early start / high use	***1.539***	***0.082 (*)***	***1.580***	***0.069 (*)***	1.350	0.199	***1.648***	***0.080 (*)***
Early start / low-medium use	1.197	0.517	1.275	0.393	1.357	0.269	1.147	0.669
Intermediate start / high use	1.267	0.370	1.303	0.354	1.318	0.283	1.313	0.351
Intermediate start / low-medium use	1.178	0.473	1.223	0.386	1.200	0.387	- [1]	
Late start / medium-high use	1.310	0.244	1.360	0.235	1.262	0.293	1.249	0.452
Late start / low use	1.270	0.302	1.248	0.347	1.340	0.163	1.147	0.625

Sample size N = 3179.[36]

[36] The sample size for the Phonics outcome is N = 3184.

The effect is the difference in the probability of achieving the expected level between a given group and the reference group, expressed as an odds ratio. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = p < 0.1, * = p < 0.05, ** = p < 0.01, *** = p< 0.001.

[1] Too few degrees of freedom to report model coefficient.

Table 13 (contd.)

ECEC start and usage	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Never 10+ hours per week	Reference	Reference	Reference	Reference	Reference	Reference
Early start / high use	1.427	0.107	1.418	0.112	2.108	0.052 (*)
Early start / low-medium use	1.257	0.370	1.239	0.401	1.489	0.345
Intermediate start / high use	1.401	0.203	1.402	0.205	1.175	0.703
Intermediate start / low-medium use	1.291	0.202	1.273	0.228	1.168	0.592
Late start / medium-high use	1.356	0.159	1.350	0.168	1.552	0.181
Late start / low use	1.360	0.143	1.329	0.179	1.481	0.261

Table 14: Results of models of child outcomes in terms of formal ECEC start age / usage factor; 60% least disadvantaged children.

ECEC start age/ usage	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Never 10+ hours per week	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Early start / high use	1.056	0.898	1.130	0.766	1.018	0.971	1.499	0.418
Early start / low-medium use	1.388	0.450	1.390	0.447	1.131	0.802	2.019	0.197
Intermediate start / high use	0.993	0.989	0.745	0.541	0.958	0.935	1.096	0.873
Intermediate start / low-medium use	1.385	0.450	1.191	0.664	1.322	0.579	1.549	0.324
Late start / medium-high use	1.052	0.901	1.017	0.967	1.222	0.671	1.232	0.661
Late start / low use	1.044	0.916	1.167	0.710	1.040	0.931	1.409	0.473

Sample size N = 1689.[37]

The effect is the difference in the probability of achieving the expected level between a given group and the reference group, expressed as an odds ratio. Odds ratios greater

[37] The sample size for the Phonics outcome is N = 1695.

than one indicate an increased probability of achieving the expected level; odds ratios less than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = p < 0.1, * = p < 0.05, ** = p < 0.01, *** = p< 0.001.

Table 14 (contd.)

ECEC start age and usage	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Never 10+ hours per week	Reference	Reference	Reference	Reference	Reference	Reference
Early start / high use	1.079	0.839	1.064	0.868	1.649	0.534
Early start / low-medium use	1.354	0.446	1.379	0.418	1.332	0.731
Intermediate start / high use	0.760	0.545	0.774	0.572	0.830	0.831
Intermediate start / low-medium use	1.325	0.469	1.335	0.458	0.872	0.851
Late start / medium-high use	1.120	0.755	1.129	0.739	1.013	0.985
Late start / low use	1.075	0.846	1.057	0.881	1.289	0.739

40% most disadvantaged children

Compared to the reference group of children who had never had 10 or more hours per week formal ECEC, children in the early start / high use group had a higher probability of achieving the expected level in KS1 Reading, KS1 Writing and KS1 Science, and a higher probability of achieving a pass in the Phonics Screening Check. All results were of borderline statistical significance.

60% least disadvantaged children

There were no statistically significant effects for the 60% least disadvantaged children.

Discussion

The educational benefits found in the KS1 and Phonics assessments for the disadvantaged children who have an early start in formal ECEC (at least 10 hours a week starting before age 2) combined with a high mean formal ECEC usage between age 2 and the start of school (> 20 hours per week) are noteworthy. While these results are of only borderline statistical significance ($p < 0.1$), this is probably attributable to the relatively small group sizes available once children have been subdivided three ways by formal ECEC start age, formal ECEC usage from age 2 to the start of school and disadvantage group, and the binary nature of the outcomes, which limits the sensitivity of analyses. However, the consistent pattern of results across a number of outcomes makes it unlikely that these results are due to chance. These findings are also consistent with the benefits for disadvantaged children from the early formal ECEC start / high formal ECEC use group found for the EYFSP outcomes in the SEED age 5 report.

Chapter conclusions

The analyses in Chapter 3 found no associations between the total amount of ECEC used between age 2 and the start of school and children's academic outcomes during school years 1 to 2. The analyses in this chapter suggest that the start age for using formal ECEC may be a more significant factor than the amount of ECEC used after age 2, especially for children from less advantaged background. Children from the 40% most disadvantaged families who first used 10 or more hours per week formal ECEC before age 2 and who had a high mean usage of formal ECEC between age 2 and the start of school (greater than 20 hours per week) performed better in the Phonics and KS1 assessments than children who had never used 10 or more hours per week formal ECEC.

These results are consistent with findings from the Effective Pre-School, Primary and Secondary Education (EPPSE) study, which found that starting group ECEC before age 3 was associated with better academic and social outcomes for children at school entry (Sylva, 2004), and also with results from the Families, Children and Child Care (FCCC) study, which found better cognitive outcomes at 51 months among children who had started group care before age 2, but only for less advantaged children (Barnes & Melhuish, 2017). These findings are also in accord with results from the SEED age 5 report, where better child outcomes from the Early Years Foundation Profile (EYFSP) where found for disadvantaged children with an early start in formal ECEC and high formal ECEC use between age 2 and the start of school.

The importance of an early start in formal ECEC appears to be largely confined to children from more disadvantaged families. This is probably because children from more advantaged families experience relatively greater benefits from their home environment, for example, from having more highly educated parents who may engage in more learning opportunities with the children, and therefore have less to gain from being exposed to out of home ECEC.

Chapter 6: The effects of home environment on child outcomes

Key points

- Higher Home Learning Environment scores were associated with children performing better on all the KS1 outcomes and on the Phonics check.
- Higher Permissive Parenting was associated with poorer child performance on the KS1 outcomes.
- Higher Parental Limit Setting was associated with better outcomes for KS1 Reading, Maths and Science.
- Higher Warmth in the parent / child relationship was associated with better child outcomes for KS1 Reading, Maths and Science and on the Phonics check.

Introduction

The analyses in previous chapters have focussed on effects associated with different patterns of ECEC use and on effects associated with ECEC quality. In these analyses a range of demographic and home environment variables have acted as control measures. These variables were included because not controlling for them might otherwise confound the relationship between ECEC use and children's outcomes.

There was considerable evidence for the influence of the home environment, including the quality of the parent/child relationship, on children's academic outcomes in school years 1 and 2. This chapter considers these effects; consideration is also given to the relative size of the effects of home environment and demographic factors.

Effects of home environment factors on outcomes

Method

The child outcomes, home environment factors, and demographic characteristics that were included in these analyses are outlined in detail in Chapter 2.

The associations between the home environment and child outcomes, controlling for demographic measures and the amount and type of ECEC used between age two and the start of school, are drawn from the initial models reported in Chapter 3; see Table 9.

The home environment variables were modelled as continuous covariates. The model results are odds ratios, giving the effect of a change of two standard deviations in the home environment covariate on the probability of a child achieving the expected level on

a given outcome. The effect of the home environment variables on the outcome measures is assumed to be approximately linear.[38]

The home environment variables are intercorrelated (see Table 15). This can make the interpretation of the coefficients difficult in models in which all the home environment variables are controlled for simultaneously. In order to ensure that the effects of home environment variables are only considered where the evidence for an effect is reliable, two models were fitted:

> **Model 1:** A model of the outcome variable in terms of a given home environment variable, controlling for demographic covariates.
>
> **Model 2:** A model of the outcome variable in terms of a given home environment variable, controlling for demographic covariates and all other home environment variables.

Table 15: Correlations between home environment variables.

[38] More technically, it is assumed that there is a linear relationship between the home environment covariates and the log odds ratio of a child achieving the expected level on a given outcome.

	Home learning environment	Household chaos	Parent's psychological distress	Parental limit setting	Parental warmth	Parental invasiveness	Authoritarian parenting	Authoritative parenting	Permissive parenting
Home learning environment	1.000	-0.179	-0.067	-0.045	0.214	-0.133	-0.182	0.259	-0.127
Household chaos	-0.179	1.000	0.319	0.236	-0.206	0.326	0.243	-0.228	0.283
Parent's psychological distress	-0.067	0.319	1.000	0.198	-0.221	0.363	0.204	-0.116	0.210
Parental limit setting	-0.045	0.236	0.198	1.000	-0.134	0.435	0.350	-0.119	0.223
Parental warmth	0.214	-0.206	-0.221	-0.134	1.000	-0.281	-0.130	0.313	-0.119
Parental invasiveness	-0.133	0.326	0.363	0.435	-0.281	1.000	0.395	-0.213	0.339
Authoritarian parenting	-0.182	0.243	0.204	0.350	-0.130	0.395	1.000	-0.248	0.460
Authoritative parenting	0.259	-0.228	-0.116	-0.119	0.313	-0.213	-0.248	1.000	-0.185
Permissive parenting	-0.127	0.283	0.210	0.223	-0.119	0.339	0.460	-0.185	1.000

The correlations were calculated for those children who have either KS1 or Phonics outcomes (N = 4935).

A positive correlation between two variables indicates that having a higher value on one variable tends to be associated with having a higher value on the other variable. A negative correlation between two variables indicates that having a higher value on one variable tends to be associated with having a lower value on the other variable. The larger the value of the correlation, the stronger these associations are.

It is the effect in Model 2 that is of interest; that is, the effect of a given home environment variable net of the effects of demographic covariates and all other home environment variables. However, if the home environment variable does not show a significant effect on the outcome in Model 1, it may be that the apparent effect in Model 2 is due to multiple intercorrelations amongst the other home environment variables. Under these circumstances the effect in Model 2 cannot be considered reliable. For this reason, effects of a home environment variable on a child outcome are only considered where the home environment variable shows a significant effect on the outcome in both Models 1 and 2.

Results

The associations between the home environment and child outcomes are summarised in Table 16. Only those results which are considered reliable are reported (see Methods).

Table 16: Summary of the associations between home environment variables and children's outcomes during school years 1 to 2.

	KS1 Reading Effect	KS1 Reading p-value	KS1 Writing Effect	KS1 Writing p-value	KS1 Maths Effect	KS1 Maths p-value	KS1 Science Effect	KS1 Science p-value
Home learning environment	***1.435***	***<0.001****	***1.427***	***<0.001****	***1.487***	***<0.001****	***1.460***	***<0.001****
Household chaos		-		-		-		-
Parent's psychological distress		-		-		-		-
Parental limit setting	***1.367***	***<0.001****		-	***1.502***	***<0.001****	***1.433***	***<0.001****
Parental warmth	***1.312***	***0.001****		-	***1.303***	***0.002****	***1.573***	***<0.001****
Parental invasiveness		-		-	***0.790***	***0.030****	***0.803***	***0.035****
Authoritarian parenting		-		-		-		-
Authoritative parenting		-		-		-		-
Permissive parenting	***0.768***	***0.006****	***0.742***	***0.001****	***0.837***	***0.038****	***0.804***	***0.045****

Sample size N = 4868.[39]

The effects are odds ratio showing the change in the probability of achieving the expected level corresponding to a two standard deviation change in the home environment covariate, controlling for all other model covariates. Odds ratios greater than one indicate an increased probability of achieving the expected level; odds ratios less

[39] The sample size for the Phonics outcome is N = 4879.

than one indicate a reduced probability of achieving the expected level. Statistically significant coefficients are indicated by stars: (*) = p < 0.1, * = *p* < .05, ** = *p* < .01, *** = *p* < 0.001.

Table 16 (contd.)

	KS1 English / Maths Effect	KS1 English / Maths p-value	KS1 All Subjects Effect	KS1 All Subjects p-value	Phonics (pass/fail) Effect	Phonics (pass/fail) p-value
Home learning environment	***1.420***	***<0.001****	***1.405***	***<0.001****	***1.727***	***<0.001****
Household chaos		-		-		-
Parent's psychological distress		-		-		-
Parental limit setting		-		-		-
Parental warmth		-		-	***1.359***	***0.013****
Parental invasiveness		-		-		-
Authoritarian parenting		-		-		-
Authoritative parenting		-		-		-
Permissive parenting	***0.779***	***0.004****	***0.786***	***0.005****		-

Home learning environment (HLE)

Higher Home Learning Environment scores were associated with better performance on KS1 Reading, Writing, Maths and Science, KS1 English & Maths, KS1 All Subjects and the Phonics Screening Check.

Household CHAOS

There were no statistically significant associations between household chaos and children's outcomes during school years 1 to 2.

Parent's psychological distress

There were no significant associations between parent’s psychological distress and children’s outcomes during school years 1 to 2.

PCCT limit setting

Higher parental limit setting was associated with a higher probability of children achieving the expected level in KS1 Reading, Maths and Science.

MORS warmth

Higher warmth in the parent/child relationship was associated with a higher probability of children’s achieving the expected level in KS1 Reading, Maths and Science. Higher warmth was also associated with better performance in the Phonics Screening Check.

MORS invasiveness

Higher invasiveness in the parent/child relationship was associated with a lower probability of children’s achieving the expected level in KS1 Maths and Science.

PSD authoritarian parenting

There were no statistically significant associations between authoritarian parenting and children’s outcomes during school years 1 to 2.

PSD authoritative parenting

There were no statistically significant associations between authoritative parenting and children’s outcomes during school years 1 to 2.

PSD permissive parenting

Higher permissive parenting was associated with poorer child outcomes on all KS1 measures.

Comparing the effect sizes associated with home environment variables and demographic variables

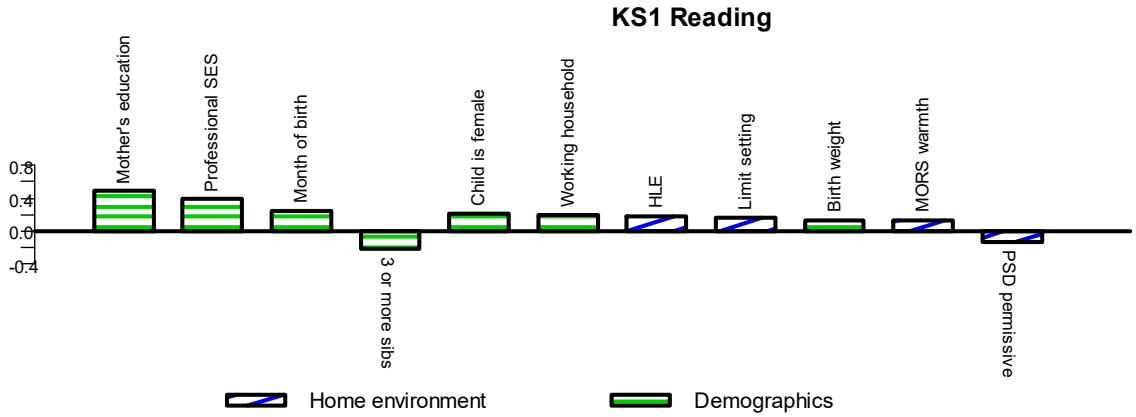
Method

In this section, figures are presented comparing the sizes of the effects of home environment and demographic covariates on the outcome variables. The demographic covariates included child's ethnic group, but because of the small sizes of most ethnic groups ethnicity effects are omitted from the results. Figures include only those associations that were statistically significant or borderline statistically significant. Models controlled for the effects of ECEC use on the outcome variables. None of these effects were statistically significant, so these effects are not included in the figures; see Chapter 3. The reported associations indicate the association over and above the influence of other factors controlled for in the models.

Results

Results are given in Figures 1 to 7.

Figure 1: Comparing effect sizes for the outcome KS1 Reading.



HLE = Home Learning Environment

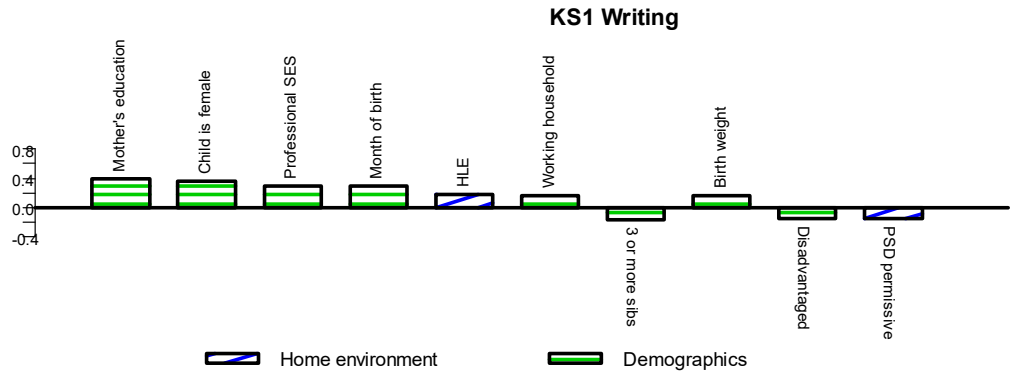
Sample size = 4868

KS1 Reading

The largest effect on the probability of achieving the expected level in KS1 Reading was of mother's education, more education associated with a greater likelihood of attaining the expected KS1 Reading score. There were also positive associations with the demographic variables family socio-economic status (professional / managerial), month of birth, child is female, working household and birth weight. There was a negative association between the probability of achieving the expected level in KS1 Reading and there being 3 or more siblings in the household.

There were positive associations between the probability of achieving the expected level in KS1 Reading and the home environment variables Home Learning Environment, limit setting and parental warmth. There was a negative association with permissive parenting.

Figure 2: Comparing effect sizes for the outcome KS1 Writing.



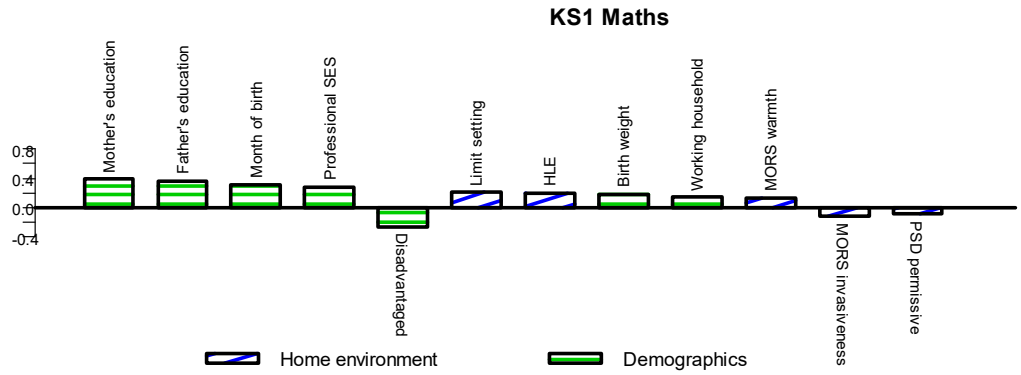
Sample size = 4868

KS1 Writing

The largest effect on the probability of achieving the expected level in KS1 Writing was for more maternal education. There were also positive associations with the demographic variables child is female, family socio-economic status (professional / managerial), month of birth, working household and birth weight. There were negative association between the probability of achieving the expected level in KS1 Writing and there being 3 or more siblings in the household and with coming from a disadvantaged family.

There was a positive association between the probability of achieving the expected level in KS1 Writing and Home Learning Environment. There was a negative association with permissive parenting.

Figure 3: Comparing effect sizes for the outcome KS1 Maths.



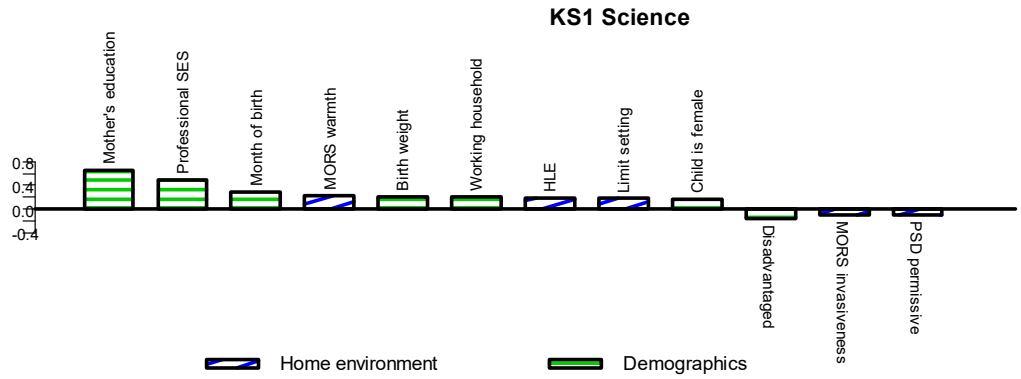
Sample size = 4868

KS1 Maths

The largest effect on the probability of achieving the expected level in KS1 Maths was for more maternal education. There were also positive associations with the demographic variables father's education, month of birth, family socio-economic status (professional / managerial), birth weight and working household. There was a negative association between the probability of achieving the expected level in KS1 Maths and coming from a disadvantaged family.

There were positive associations between the probability of achieving the expected level in KS1 Maths and the home environment variables limit setting, Home Learning Environment and parental warmth. There were negative associations with parental invasiveness and permissive parenting.

Figure 4: Comparing effect sizes for the outcome KS1 Science.



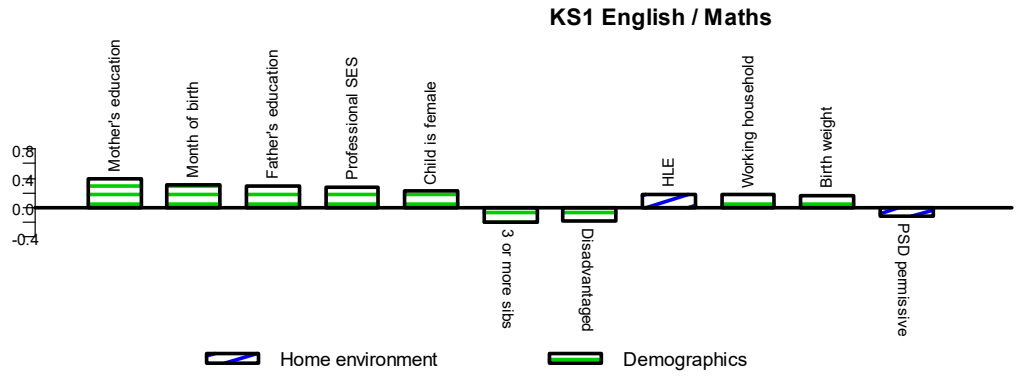
Sample size = 4868

KS1 Science

The largest effect on the probability of achieving the expected level in KS1 Science was for more maternal education. There were also positive associations with the demographic variables family socio-economic status (professional / managerial), month of birth, birth weight, working household and child is female. There was a negative association between the probability of achieving the expected level in KS1 Science and coming from a disadvantaged family.

There were positive associations between the probability of achieving the expected level in KS1 Science and the home environment variables parental warmth, Home Learning Environment and limit setting. There were negative associations with parental invasiveness and permissive parenting.

Figure 5: Comparing effect sizes for the outcome KS1 English / Maths.



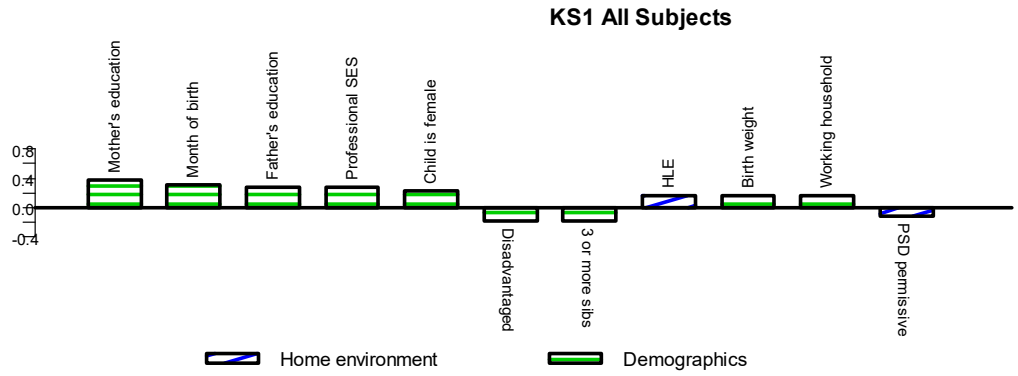
Sample size = 4868

KS1 English and Maths

The largest effect on the probability of achieving the expected level in KS1 English and Maths was for more maternal education. There were also positive associations with the demographic variables month of birth, father's education, socio-economic status (professional / managerial), child is female, working household and birth weight. There were negative association between the probability of achieving the expected level in KS1 English and Maths and there being 3 or more siblings in the household and with coming from a disadvantaged family.

There was a positive association between the probability of achieving the expected level in KS1 English and Maths and Home Learning Environment. There was a negative association with permissive parenting.

Figure 6: Comparing effect sizes for the outcome KS1 All Subjects.



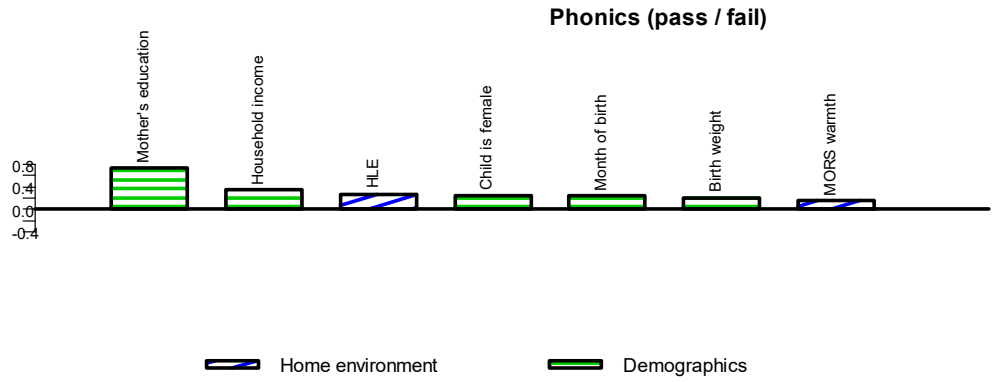
Sample size = 4868

KS1 All Subjects

The largest effect on the probability of achieving the expected level in KS1 All Subjects was for more maternal education. There were also positive associations with the demographic variables month of birth, father's education, family socio-economic status (professional / managerial), child is female, birth weight and working household. There were negative association between the probability of achieving the expected level in KS1 All Subjects and coming from a disadvantaged family and there being 3 or more siblings in the household.

There was a positive association between the probability of achieving the expected level in KS1 All Subjects and Home Learning Environment. There was a negative association with permissive parenting, i.e. where parents had higher permissive scores children had poorer outcomes.

Figure 7: Comparing effect sizes for the outcome Phonics (pass / fail).



Sample size = 4879

KS1 Phonics Screening Check

The largest effect on the probability of achieving the expected level in the Phonics Screening Check was for more maternal education. There were also positive effects of the demographic variables household income, child is female, month of birth and birth weight.

The probability of achieving the expected level in Phonics was positively associated with the home environment variables Home Learning Environment and parental warmth.

Chapter conclusions

It is clear that home environment factors, including the quality of the parent/child relationship have considerable influence on children's educational outcomes during school years 1 to 2. Given the timing of the measurements, and because an extensive number of factors were controlled for in the analyses, the relationships between home environment and child outcome are assumed to be causal.

The most influential home environment variable was Home Learning Environment, which was measured during the preschool years. This measure had a significant positive effect on all the child outcomes. Also prominent was the negative effect of permissive parenting: this measure had a negative association with all the Key Stage 1 outcomes. Also influential was the quality of the parent/child relationship, with positive effects of parental warmth and negative effects of parental invasiveness being found for a number of outcomes. Parental limit setting, which is inversely related to permissive parenting, was also found to be significantly associated with better reading, maths and science outcomes.

Parent's psychological distress was not associated with children's Phonics and KS1 outcomes, which is consistent with results for EYFSP outcomes discussed in the SEED age 5 report. However, whilst higher levels of household chaos were associated with poorer EYFSP outcomes in the SEED age 5 report, there were no significant associations between household chaos and children's Phonics and KS1 outcomes. It is

possible that by age 7, attending school for two years has been able to counteract some of the disadvantage that children with a more difficult home environment experience at younger ages.

Demographic covariates were significantly associated with all the child outcomes. The effects of demographic outcomes tended to be larger than those of the home environment measures. The largest influence on all the child outcomes analysed was mother's education, more maternal education associated with better academic achievement. Father's education was also a similar significant influence on certain child outcomes, even once mother's education was controlled for.

It is well established that girls tend to perform better than boys at Key Stage 1, with a smaller gender gap for maths results (Department for Education and Skills, 2007). In the current results, girls had significantly better outcomes on the Phonics check and on all KS1 outcomes except maths.

Children who were older in their school year performed better, as did children with higher birth weights. There were also benefits associated with coming from a household with higher socio-economic status, higher income and a household where someone was working. There were negative associations with coming from a disadvantaged family and with coming from a family with three or more siblings.

The effects of home environment and demographic factors on children's academic outcomes show a fair degree of continuity between the age 6 to 7 outcomes considered here and the outcomes considered in earlier waves of the SEED study.[40]

[40] See (Melhuish, Gardiner and Morris 2017; Melhuish and Gardiner 2018; Melhuish and Gardiner 2020).

Chapter 7: Discussion and conclusions

Background

As discussed in Chapter 1, the provision of ECEC in the UK has changed radically in the last twenty years. Following evidence from the Effective Pre-school, Primary and Secondary Education (EPPSE) study of the positive effects of ECEC upon children's development, (e.g., Melhuish et al., 2008c; Sylva et al., 2004), the following policies have been introduced:

- For three- and four-year-olds, the introduction of free universal ECEC of 15 hours/week or 30 hours/week free ECEC when a parent is employed for 16 hours/week.
- An increase in parental leave from 5 months to 12 months post birth, resulting in great reductions in the use of ECEC in the first year of life.
- The introduction of free ECEC from two years of age for the 40% most disadvantaged families.
- Increases in tax allowances for ECEC for many families.
- Substantial increases in government-funded spending and initiatives to improve ECEC quality and staff competence.

Hence the ECEC landscape has changed greatly since the time of the previous substantial study of ECEC in England, i.e. the EPPSE study, largely as a consequence of policy being influenced by the EPPSE results. This changed ECEC landscape has resulted in almost all children attending some early childhood education, and the quality of ECEC has improved substantially (Melhuish, 2016; Melhuish & Gardiner, 2019), largely through the reduction in the extent of poor quality ECEC, substantially more prevalent in earlier decades. In the light of this changed ECEC landscape the Department for Education decided to fund the SEED study in order to examine what further policy developments might arise from the new ECEC situation for children and its relationship to their development. Earlier reports have dealt with children at ages three, four and five years. This report deals with academic outcomes for children at age seven years.

Aims

The main objectives of this report are:

1. To study the associations between the amount of different types of formal and informal ECEC that children receive between the age of two and the start of school and children's Phonics and Key Stage 1 outcomes during school years 1 and 2.

2. To study the associations between the quality of the formal group ECEC settings that children have attended between ages two and four and children's Phonics and Key Stage 1 outcomes during school years 1 and 2.

3. To consider how age of starting formal ECEC may affect children's Phonics and Key Stage 1 outcomes during school years 1 and 2.

4. To investigate the impact of the home environment, parenting and the quality of the parent/child relationship on children's Phonics and Key Stage 1 outcomes during school years 1 and 2.

The findings of this study show a considerable degree of continuity with the earlier SEED studies looking at children's outcomes at ages three, four, and five years, as well as some divergence from earlier findings. The findings derive from models that include statistical control for a wide range of background factors.

Models have considered the effects of a number of aspects of ECEC use associated with children's attainment in phonics assessments in year 1 and Key Stage 1 assessments in year 2: i.e. the amount and type, timing and quality of ECEC used. This leads to a potentially complex picture in which the final conclusions drawn may need to take account of a number of different modelling strategies. Additionally, models considered the effects associated with a range of home environment and demographic variables upon children's attainment in Phonics assessments in year 1 and Key Stage 1 assessments in year 2.

It should also be borne in mind, particularly where results are new or unexpected, that conclusions should be tentative until results can be confirmed by supporting evidence from other studies.

Assessing the effects of ECEC on child development

The possibility of confounding

In observational studies, the possibility needs to be considered that results are influenced by confounding from unobserved variables. In this study, the risk of confounding is reduced by controlling the models for a wide range of home environment and demographic variables. It is likely that potential confounders, even if not directly controlled for, will be correlated with one or more of these home environment and demographic variables, so that the controlled models reduce the effect of confounding even if it is not eliminated completely. There remains the risk of a confounder that is largely independent of the home environment and demographic variables. A possible example is whether or not a child has a Special Educational Need (SEN). Children with an SEN may be less likely to use formal ECEC and are likely to have poorer cognitive and educational outcomes. This confounding could increase the apparent positive effects of formal ECEC use on child outcomes.

The amount and type of ECEC used

There were no significant associations found between the amount of formal group ECEC, formal individual ECEC or informal individual ECEC used between age 2 and the start of school and children's Phonics and Key Stage 1 outcomes during school years 1 and 2. This is probably partly attributable to the relative insensitivity of the binary outcomes analysed, as binary outcomes have less power to detect small differences than continuous outcomes. The lack of associations between children's ECEC use between age 2 and the start of school and children's academic outcomes is consistent with the age 5 results for children's EYFSP outcomes (Melhuish & Gardiner, 2020). For the age 5 outcomes, the age when children started attending formal group ECEC was found to be a more significant predictor of children's performance.

The effects of ECEC on children's cognitive outcomes found in the SEED study are more limited than those found in the EPPSE study (1997-2012), which is the last comparable study (Sylva, 2004). It is worth noting that the EPPSE study made use of a comparison group without any group ECEC. This was possible because the EPPSE sample started school before the introduction of free universal ECEC for 3- and 4-year-olds, which started in 2004. By the time of the SEED study there were extremely few families not using ECEC (19 families, or 0.5%, using no ECEC) because of the availability of universal free ECEC for 3- and 4-year-olds. Hence, in the SEED study this meant that comparisons involving amount of ECEC involve variations amongst children who essentially all had some ECEC, so all potentially experienced some possible benefits. This lack of a comparison group without any ECEC limits the possibility of finding effects related to ECEC similar to those found in the earlier EPPSE study.

Also, the Key Stage 1 measures used in EPPSE were more detailed than those available in SEED. The data available in the EPPSE study included raw Key Stage 1 scores that could be decimalised into a continuous variable and thus allowed for a more differentiated analysis. However, for this SEED report the Key Stage 1 data analysed were binary (met expected level or above = 1; did not meet expected level = 0). The analysis methods for binary outcome data are less sensitive to finding significant results than the analysis methods for the continuous outcomes used in the EPPSE study.

In addition, comparisons of ECEC quality in the settings in the EPPSE study with equivalent ECEC quality measures in the SEED study reveal that the overall ECEC quality in the SEED study is higher (Melhuish & Gardiner, 2017). This improvement in ECEC quality in England over time (15+ years) was accompanied by an improvement in manager and staff qualifications and training. It is probable that the increase in qualifications and training is related to the improvement in quality levels, and may well be a consequence of the increased funding and initiatives that the government has devoted to increasing ECEC quality in the intervening period between EPPSE and SEED. This means that there is very little ECEC in the SEED study that corresponds to the low ECEC quality group used in EPPSE. As many of the significant effects in EPPSE relied on comparison with a low quality ECEC group, which comprised around 30% of the EPPSE sample, comparisons involving ECEC in SEED are not equivalent to those in EPPSE.

Finally, the EPPSE study did not consider individual ECEC, whether formal or informal, that may have occurred in parallel with the formal group ECEC. As the SEED analyses simultaneously consider formal group, formal individual and informal individual ECEC as potentially influencing child outcomes, this difference in the nature of ECEC included in the analyses may well be related to differences between the EPPSE and SEED results.

When all of these differences between the EPPSE and SEED studies are considered it is not surprising that there are differences in the results found in the EPPSE and SEED studies. As many of the critical comparisons in EPPSE involve a no-ECEC group or a low quality ECEC group as the reference group, the lack of substantial numbers in these groups for SEED will affect the pattern of results as compared with EPPSE. In particular, the differences mean that any effects associated with ECEC are likely to be smaller in the SEED study than in the EPPSE study, and that the likelihood of finding statistically significant results related to ECEC is reduced in the SEED study as compared with the EPPSE study.

The quality of ECEC

The quality of ECEC attended by some SEED children was measured for age 2 to 3 years (Wave 1) and for age 3 to 4 years (Wave 2). There were differences between the measures applicable for the 2 age groups. The results did not indicate a significant effect of the quality of formal ECEC attended between ages 2 and 3 years, when that quality measure was considered alone, as was also found for cognitive development at 3 years of age in a longitudinal study in Norway (Eliassen, Zachrisson, & Melhuish, 2018).

However, the results did indicate the quality of ECEC attended between ages 3 and 4 years was associated with child outcomes in years 1 and 2 of primary school. Specifically, attending higher quality formal group ECEC between ages 3 and 4 was associated with better outcomes in KS1 Maths, KS1 Science and the combined KS1 English and Maths outcome. Several of the associations found are of only borderline statistical significance, which is likely to reflect the relatively small sample available for the quality analysis, as well as the binary outcomes limiting the sensitivity of analyses. However, taken together, the significant and borderline significant effects found over several child outcomes provide good evidence for a causal association between attending higher quality formal group ECEC between ages 3 and 4 and better child academic outcomes during school years 1 to 2. Note that this finding is for quality that is on average substantially higher overall than that found in the EPPSE study, and, indeed, than the quality in most studies that have investigated the relationship between ECEC quality and child outcomes.

The beneficial effects of quality are predominantly determined by the ECERS-R scale, which is a measure of overall ECEC quality for children three years and older, or with composites of the quality measures, with only one borderline significant effect associated with the ECERS-E quality measure, which focusses specifically on the educational aspects of ECEC for the over threes. This suggests that the overall quality of ECEC prior to starting school may be more influential upon academic development than the specifically educational aspects measured by ECERS-E. However, it should be borne in mind that all ECEC quality measures are themselves correlated with each other. Such findings are consistent with much international research (Melhuish et al., 2015)

While the ECEC quality measures at age 2 to 3 years (Wave 1) were not associated with educational outcomes in years 1 and 2, higher quality on the overall Wave 1 and 2 quality measure was associated with a significantly higher probability of children achieving the expected level in KS1 Maths. Also, higher quality on the overall Wave 1 and 2 quality measure was associated with a higher probability of children achieving the expected level in KS1 English / Maths (borderline significant effect). This suggests that attending higher quality formal group ECEC between ages 2 and 4 is associated with better child educational outcomes in years 1 and 2, specifically, KS1 Maths, KS1 Science and with the combined KS1 English and Maths outcome.

The age when formal ECEC use starts

For children in the 40% most disadvantaged group, those in the early start / high use formal ECEC group (at least 10 hours a week starting before age 2, and > 20 hours per week between age 2 and the start of school) had a higher probability than the reference group of achieving the expected level in KS1 Reading, KS1 Writing and KS 1 Science, and a higher probability of achieving a pass in the Phonics Screening Check. While all results were of borderline statistical significance they do form a consistent pattern.

Whereas for children in the 60% least disadvantaged group, there were no statistically significant effects related to timing of start of formal ECEC; it seems that their overall home-based advantages outweigh any differences in ECEC starting age.

The educational benefits found in the KS1 and Phonics assessments for the disadvantaged children with an early start in formal ECEC (at least 10 hours a week starting before age 2) combined with a high mean formal ECEC usage between age 2 and the start of school (> 20 hours per week) are noteworthy. Although these results are of only borderline statistical significance ($p < 0.1$), this low level of statistical significance is probably attributable to the small group sizes once children are subdivided by formal ECEC start age, amount of formal ECEC usage from age 2 to the start of school, and disadvantage group. However, the consistent pattern of results across a number of outcomes makes it unlikely that these results are due to chance. These findings are also consistent with the benefits for disadvantaged children from the early formal ECEC start / high formal ECEC use group found for the EYFSP outcomes in the SEED age 5 report. Also, in a longitudinal study in Norway, starting group ECEC before 2 years of age was found to be linked to improved non-verbal cognitive development (Eliassen, 2018). In this context the findings appear more secure.

The Home Environment

The SEED study is unique in being the only longitudinal study with such a wide range of measures of the home environment. This adds considerably to the value of the SEED study as it illuminates the influence of the home environment on children's development in ways that have not previously been documented.

Home environment factors, including parenting and the quality of the parent/child relationship have considerable influence on children's educational outcomes during primary school years 1 to 2. These effects are considerably stronger and more consistent than any effects associated with ECEC variables. Given the timing of the measurements, and because of the extensive number of child, family and ECEC factors that were controlled for in the analyses, the significant relationships found between the home environment factors and child outcome are assumed to be causal.

The most influential home environment variable was Home Learning Environment (HLE), which had a significant positive effect on all the child outcomes in years 1 and 2. Thus children receiving a more stimulating home learning environment did better on all educational outcomes measured. This finding replicates findings from the EPPSE study (Melhuish et al., 2008a, 2008c; Sammons et al., 2008a). Also it is a result that is supported in other studies such as the Millennium Cohort Study (MCS), a longitudinal sample of over 15,000 children in the UK, in which child development differences were linked to the HLE in ways that could explain part of the socioeconomic gap in child development outcomes (Kelly et al., 2011). Research in the USA has also found that the early home learning environment has long-term influences upon development (Liang et al., 2020).

Another strong consistent finding was the negative effect of permissive parenting, where parents show little constraint on child behaviour. Where permissive parenting was high, children had a lower probability of achieving the expected level on all Key Stage 1 outcomes. Additionally, more parental limit setting, which can be considered as partly the inverse of permissive parenting, was found to be significantly associated with better reading, maths and science outcomes in Key Stage 1. Hence, it appears that where

parents provide children with more structure in their home environment the children do better at their Key Stage 1 assessments. It is noteworthy that Baumrind (1966, 1996) found that lack of parental control was linked to poorer social competence in later childhood.

Some aspects of the home environment measured during SEED did not show any significant relationships with academic outcomes in years 1 or 2. Whilst higher levels of household chaos were associated with poorer EYFSP outcomes in the SEED age 5 report, there were no significant associations between household chaos and children's Phonics and KS1 outcomes in years 1 and 2. It is possible that by age 7 attending school for two years has been able to partly compensate for some of the disadvantage that children with a more difficult home environment experience at younger ages, or possibly any small effects may not be detectable with the limited sensitivity of analyses with binary outcomes. Also it is possible that the teacher ratings of the EYFSP are picking up on aspects of socio-emotional development that are not apparent in the academic phonics and Key Stage 1 assessments.

Other home environment factors that did not show any significant relationship with academic outcomes in primary school years 1 and 2, include:

- Parents' psychological distress was not associated with children's Phonics and KS1 outcomes, which is consistent with results at age five for EYFSP outcomes.
- Parents' authoritarian or authoritative parenting style was not associated with any outcomes in years 1 and 2.

It is possible that these aspects of the home environment may be more likely to influence socio-emotional aspects of children's development, rather than the academic Phonics and Key Stage 1 assessments. Also more evidence relating parenting style to child development occurs for older children and adolescents, and most strongly for socio-emotional outcomes (e.g., Ladd & Pettit, 2002). This interpretation is consistent with findings in the USA on parenting style reported by Baumrind (1996).

Demographic Factors

Demographic covariates were significantly associated with all the child outcomes. The effects of demographic outcomes tended to be larger than those of the home environment or ECEC measures. The largest positive influence on all the child outcomes studied was a higher level of mother's education. Father's education was also a significant influence on certain child outcomes, even controlling for mother's education.

It is well established that girls tend to perform better than boys at Key Stage 1, but with a smaller gender gap for maths results (Department for Education and Skills, 2007). In the current results, girls had significantly better outcomes on the Phonics check and on all KS1 outcomes except maths.

Children who were older in their school year performed better, as did children with higher birth weights. There were also benefits associated with coming from a household with higher socio-economic status, higher income and a household where someone was working. These findings are reminiscent of finding on the socioeconomic achievement gap for early cognitive development reported by Feinstein (2003). Hence, there were negative associations with coming from a disadvantaged family as well as with coming from a family with three or more siblings. The effects related to number of siblings may

indicate that parents may not be able to give as much individual attention to children when attention may be divided amongst more children in the family.

The effects of home environment and demographic factors on children's academic outcomes show a fair degree of continuity between the age 6 to 7 outcomes considered here and the outcomes considered in earlier waves of the SEED study[41], as well as being consistent with other research in the UK (e.g. Feinstein et al., 2015; Field, 2010; Melhuish et al., 2008c;), in Sweden (Bjorklund, Lindahl & Plug, 2006), and many other countries (Chielewski, 2019).

Overall Summary

The SEED study has investigated the influence of ECEC upon children's development following a period of substantial change in the UK policy landscape for ECEC. This report focuses on academic outcomes in school years 1 and 2 which were binary in nature so limiting the sensitivity of analyses. Nonetheless several interesting results have emerged. While, in the analysis of binary academic outcomes, overall amount of ECEC appears to be unrelated to child academic outcomes in school years 1 and 2, better quality ECEC does relate to better child outcomes. Additionally, for disadvantaged children an early start to formal ECEC with a higher amount of formal ECEC between age 2 and the start of school was associated with better child outcomes, although this was not the case for children from more advantaged families.

The home environment proved to be a powerful and consistent influence upon children's outcomes. The home learning environment showed the widest range of effects, but the parent/child relationship was also important, and parental discipline in terms of setting limits to children's behaviour was also substantially influential upon children's development.

The analyses also revealed important effects for children's development associated with a range of demographic factors. Children's characteristics were influential in that girls did better than boys, heavier birth weight was influential, and children's age in the school year had substantial effects, with older children doing better. This latter point may be important to consider in the timing of transitions to school and between school years, as well as in how academic performance might be adjusted for age. Family characteristics were also important, particularly parental education, with socio-economic status, income and being in a working household all being linked to children's development. It was also the case that children from disadvantaged families appeared to benefit more from an early start with a greater amount of ECEC.

While there are some child development differences associated with start age and quality of ECEC, the overall effects for child development associated with differences in ECEC experience found in SEED are somewhat less that those reported in the earlier substantial study, the Effective Pre-school, Primary & Secondary Education (EPPSE) project. These differences reflect the changes in the ECEC landscape in the UK over the last two decades. Compared with twenty years ago, now almost all children attend some early childhood education, and the quality of ECEC has improved substantially (Melhuish & Gardiner, 2019, Melhuish 2016), largely through the reduction in the extent

[41] See (Melhuish, Gardiner and Morris 2017; Melhuish and Gardiner 2018; Melhuish and Gardiner 2020).

of poor quality ECEC that was substantially more prevalent in earlier decades. Hence, there has been a levelling up in the ECEC experiences of children across the socio-economic spectrum, with less variation in amount or quality of ECEC experiences across the population. A consequence of this levelling up of ECEC experiences is that any effects of ECEC differences upon child development are reduced. This can be regarded as a “good news” story as the ECEC situation for children now is substantially better than it was at the end of the twentieth century. It is noteworthy that the policy changes leading to these benefits were driven by ground-breaking research, which has come to be recognised across the world.

Overall, there is much of interest to policy-makers, practitioners and parents in the results of the SEED study.

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Appendix A: Multiple imputation and bias

Missing data mechanisms

Where there are missing data, the way in which data values are missing can be categorised as follows:

1. Data missing completely at random (MCAR)
2. Data missing at random (MAR)
3. Data missing not at random (MNAR)

Missing data is classified as **missing completely at random** if the probability that an item is missing does not depend on the data in any way. In practice, it is unusual for data to be missing in this way.

Missing data is classified as **missing at random** if the probability that data is missing depends only on the observed data and not on unobserved data.

Missing data is classified as **missing not at random** if the probability that data is missing depends on unobserved as well as observed data.

Where data are missing not at random, it is usually not possible to correct for the effects of missing data.

If data are missing at random, then a number of methods, including multiple imputation, produce unbiased results. If data are missing completely at random then complete cases analysis also produces unbiased results; see Table 17.

Table 17: Types of missingness and analysis bias.

Type of missing data	Analysis of multiply imputed data	Analysis of complete cases data
Missing completely at random	Unbiased	Unbiased
Missing at random	Unbiased	Biased
Missing not at random	Biased	Biased

Are the SEED missing data missing at random?

Where data are **missing at random**, this means that the propensity for a data point to be missing is not related to the missing data, but it may be related to some observed data. In these analyses there are a large number of variables included in the multiple imputation model that are likely to be linked to missingness of other variables in the study. It is therefore probable that the missing at random assumption holds at least approximately. That is, the probability that an observation is missing is likely to be fairly well predicted by the known demographic, parenting, home environment and ECEC usage data. Under these circumstances, the analysis of multiple imputed data will be free from the bias that would affect a complete cases analysis.

Appendix B: Factor analysis of quality variables

Introduction

Two overall quality measures used in the analyses in Chapter 4 were derived using factor analysis:

1. For children with Wave 2 quality data, a common factor was extracted from the Wave 2 SSTEW, Wave 2 ECERS-R and Wave 2 ECERS-E scales.

2. For children with Wave 1 and Wave 2 quality data, a common factor was extracted from the Wave 1 SSTEW, Wave 1 ITERS-R, Wave 2 SSTEW, Wave 2 ECERS-R and Wave 2 ECERS-E scales.

Wave 2 quality data

The correlations between the Wave 2 quality measures are shown in Table 18.

Table 18: Correlations between Wave 2 quality measures.

	ECERS-R	ECERS-E	SSTEW
ECERS-R	1.000	0.804	0.883
ECERS-E	0.804	1.000	0.832
SSTEW	0.883	0.832	1.000

The loadings of the Wave 2 quality measures onto a single common factor are shown in Table 19.

Table 19: Factor loadings for factor analysis of Wave 2 quality data.

Variable	Loading
ECERS-R	0.924
ECERS-E	0.870
SSTEW	0.956

Waves 1 and 2 quality data

The correlations between quality measures from Waves 1 and 2 are shown in Table 20.

Table 20: Correlations between quality measures from Waves 1 and 2.

		Wave 1		Wave 2		
		ITERS-R	SSTEW	ECERS-R	ECERS-E	SSTEW
Wave 1	ITERS-R	1.000	0.882	0.741	0.568	0.652
	SSTEW	0.882	1.000	0.719	0.648	0.719
Wave 2	ECERS-R	0.741	0.719	1.000	0.822	0.895
	ECERS-E	0.568	0.648	0.822	1.000	0.829
	SSTEW	0.652	0.719	0.895	0.829	1.000

The loadings of the Wave 1 and 2 quality measures onto a single common factor are shown in Table 21.

Table 21: Factor loadings for factor analysis of quality data from Waves 1 and 2.

Variable		Loading
Wave 1	ITERS-R	0.763
	SSTEW	0.786
Wave 2	ECERS-R	0.954
	ECERS-E	0.859
	SSTEW	0.933

Appendix C: Numbers of children who have used each type of ECEC

The numbers and percentages of children in the SEED study who have used each type of ECEC between age 2 and the start of school are shown in Table 22. The sample consists of the 3560 children who have ECEC use data from age 2 to the start of school and who have at least one of the KS1 outcomes / the Phonics check outcome.

Table 22: Numbers / percentages of children who have used each type of ECEC.

	N	%
Formal group ECEC	3518	98.8
Formal individual ECEC	468	13.1
Informal individual ECEC	1878	52.8
Any ECEC	3541	99.5
All children	3560	100.0

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