Department for Education

Study of Early Education and Development (SEED): Financial returns to early education spending

Research Report

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SEED Study of Early Education & Development

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Executive Summary

This report is part of the Study of Early Education and Development (SEED), an eight-year study commissioned by the Department for Education (DfE) in 2013 to explore how childcare and early education can give children the best start in life and the factors which are important for the delivery of high quality provision.[1] The study is being undertaken by NatCen Social Research, the University of Oxford, Action for Children and Frontier Economics, and is due to be completed in 2021. The aim of SEED is to provide a robust evidence base to inform the development of policy to improve children's readiness for school.

This is the third report from the value for money component of SEED. The first report provided cost information for the delivery of early education in 2015 (Blainey & Paull 2017), while the second presented estimates of the monetary value of potential impacts of early education at ages two and three on child outcomes at ages three, four and seven (Paull & Xu 2017). This report combines this information with the estimated impacts of early education on two measures of child development at ages three and four, presented in the Annex, to estimate the financial returns to early education spending from these impacts in the form of benefit-to-cost ratios (BCRs). The main body of the report was written by Frontier Economics, while the impact analysis presented in the Annex was undertaken by Edward Melhuish and Julian Gardiner. Later work in the value for money component of SEED will consider the longer-term financial returns using estimated impacts of early education at ages two and three on child outcomes at age seven.

The BCR is the value of the benefits divided by the cost. If this ratio is greater than one, the estimated value of the benefits exceeds the delivery cost. If the ratio is less than one, it shows the extent to which part of the cost of delivery is repaid in later benefits. This report compares the BCRs across different types of provision (part-time and full-time, provider type and quality of provision) and for children with different levels of disadvantage, indicating the types of provision offering the greatest potential return for each pound invested.

It is important to note that the estimated BCRs should not be treated as measures of absolute value for money but as indicators of the financial return to spending on different types of early education which arise from consequent improvements in children's verbal and socio-emotional development. In addition, there is no method to combine the BCRs for the two measures of child development as the impacts may be correlated and simple summation could potentially double count some of the benefits.

[1] Further information about the SEED study can be found at http://www.seed.natcen.ac.uk/ and reports published to date are available at https://www.gov.uk/government/collections/study-of-early-education-and-development-seed.

The following caveats should also be noted regarding the BCR estimates:

- The impact estimates underpinning the BCRs should be treated with caution because they only identify a causal impact to the extent that the control variables used in the impact analysis adequately control for other factors related to early education that may drive the outcomes.

- The impact estimates underpinning the BCRs should also be treated with caution because the comparison groups of children using no or no/low early education are very small (387 two-year-old children with no early education and 165 three-year-olds with no/low early education) and potentially atypical that is, the small number of children using no or low early education may differ from children using some or more early education in ways that affect outcomes but are not captured in the survey measures.

- The BCRs may not capture the full value of the benefits of early education because the scope of SEED is limited to estimating the impacts on child development and does not include other potential impacts such as on parental employment. In addition, limitations in the existing literature mean that only some measures of the potential impacts on child development could be valued. This needs to be balanced against the possibility that the value of the benefits may be overstated because the valuation of changes in child outcomes implicitly assumes that there is no "fade-out" in impact as the child ages.

- Due to insufficient information in the evidence sources, confidence intervals for the BCRs could not be estimated and there is no indication of the degree of confidence that the findings represent true differences in the population.

Combining estimates of the hourly costs of delivery with average annual hours of use highlighted the following patterns in the annual delivery costs in 2015[2]:

- The mean annual cost is considerably higher for full-time provision than part-time provision in direct proportion to the differences in the annual hours.[3] The mean annual hourly cost is estimated to be £1,135 for part-time early education and £4,153 for full-time early education at age two and £1,369 for part-time early education and £2,935 for full-time early education at age three.

- The mean annual cost is generally higher for childminders than PVI (private, voluntary and independent) and maintained providers, reflecting both a relatively

[2] More recent estimates of hourly delivery costs based on data collected in March to July 2018 are available in Paull & Xu (2019).

[3] Part-time early education is defined as average weekly hours of 15 or less across the year and full-time early education is defined as average weekly hours of more than 15 across the year.

higher hourly cost and higher annual hours. The mean annual cost is higher for maintained providers than for PVI providers because a higher hourly cost outweighs the effects of lower annual hours for maintained providers.

- For group-based providers, the mean annual cost does not vary to any substantial degree across the three quality levels for either age group, reflecting the absence of strong patterns in either the hourly cost or in annual hours across quality levels.

- The mean annual cost is highest for the least disadvantaged children and lowest for the most disadvantaged children in direct proportion to the differences in the annual hours for both age groups because the hourly cost estimates do not differ by child disadvantage level.

The monetary value of similar-sized improvements in the verbal development and socio-emotional development measures at age three or age four are quite similar: a change in these outcomes of one standard deviation is estimated to have a lifetime value of around £8,000.

The key findings from the estimates of the impacts of early education at ages two and three on verbal development (British Ability Scales (BAS)) and socio-emotional development (Strengths and Difficulties Questionnaire (SDQ) total difficulties score) at ages three and four respectively are:

- Part-time and full-time early education at age two are associated with positive impacts on verbal development, but there is no strong evidence of similar positive impacts for early education at age three or for socio-emotional development for early education at either age.

- For two-year-olds in full-time early education, the impacts on verbal development are higher for children attending childminders than other provider types. The evidence does not indicate any consistent associations between quality level and either development measure for early education at either age.[4]

- The positive impacts on child development for early education at both ages are higher for those in the moderately and least disadvantaged groups than for those in the most disadvantaged groups.

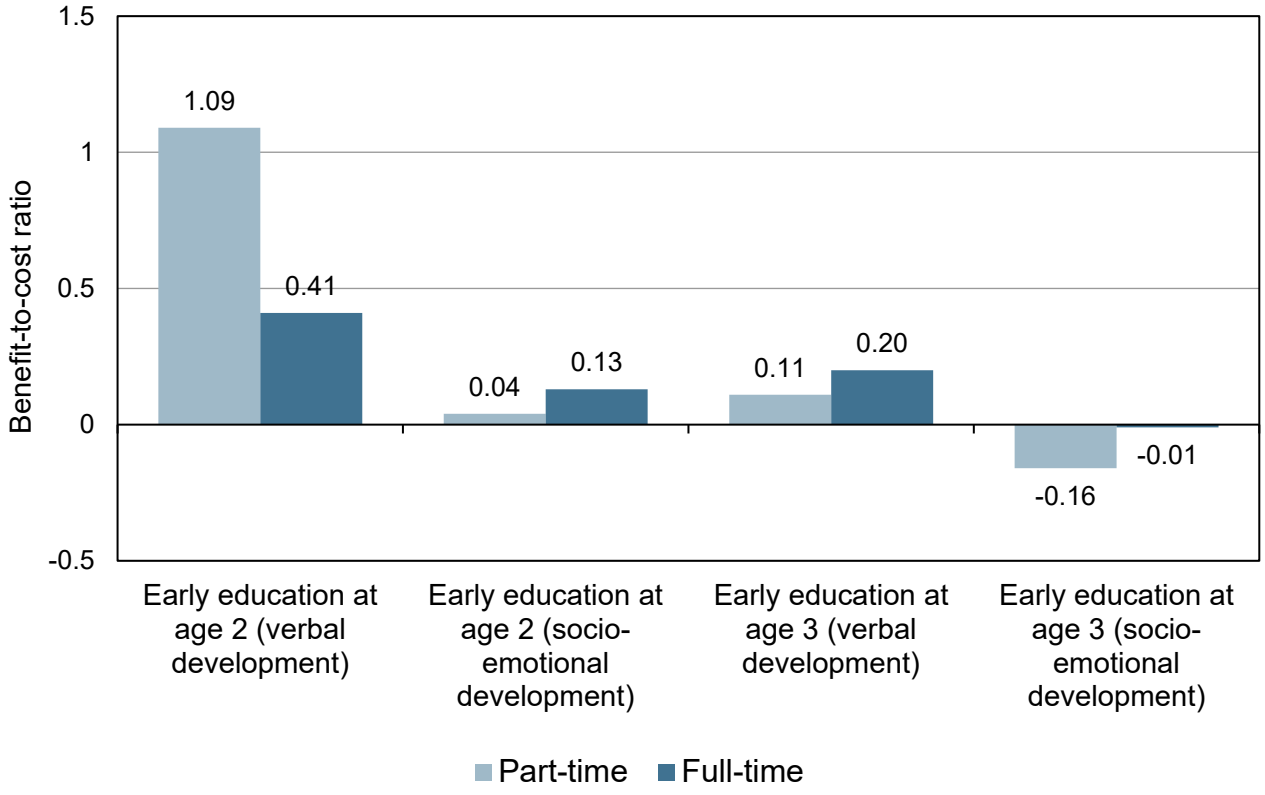
Combining the valuation with the estimated impacts generated an estimated value of the benefits per child from improvements in verbal development of £1,233 for part-time early education and £1,706 for full-time early education at age two, and £157 for part-time

[4] This may be surprising in light of the evidence cited in Melhuish & Gardiner (2018) on the importance of quality for child development using other measures of outcomes. The comparisons between quality and impact are considered in more detail in the Annex.

early education and £577 for full-time early education at age three. The estimated value of the benefits from improvements in socio-emotional development are considerably smaller, reflecting the much smaller estimated impacts.

Figure 1 presents the estimated BCRs for part-time and full-time early education for all provider types and children, highlighting how differences in the estimated impacts lead to greater returns through verbal development than socio-emotional development. It also shows that the BCRs are notably higher for early education at age two than for early education at age three, driven by larger impacts which are not outweighed by a higher delivery cost for early education at age two.

Figure 1: BCRs by part-time and full-time early education



The figure also highlights the relative financial returns for part-time and full-time early education:

- The BCR using the verbal development measure is higher for part-time than full-time for two-year-olds because the annual cost is so much lower while there is little difference in the value of the impact.
- However, the BCRs using the socio-emotional development measure for two-year-olds and the BCRs using both verbal and socio-emotional development for three-year-olds are slightly higher for full-time than part-time because the substantially higher impacts outweigh the higher cost for full-time.

Comparing the returns across different types of provision and children show that:

- The BCRs are generally higher for children attending childminders than for other provider types, primarily reflecting larger impacts rather than lower costs. The pattern between PVI and maintained providers is more mixed, mainly driven by the mixed pattern in the impacts.

- There is no consistent pattern in the BCRs across setting quality level, reflecting the absence of strong associations between cost or impacts and quality. This could be due to insufficient variation in quality (particularly in the proportion of settings with lower quality) to identify any clear patterns.[5]

- The BCRs are higher for children in the moderately and least disadvantaged groups than those in the most disadvantaged group: the higher annual costs are outweighed by the higher impacts for children in the moderately and least disadvantaged groups.

[5] The associations between quality and impact are considered in more detail in the Annex.

1. Introduction

This report is part of the Study of Early Education and Development (SEED), an eight-year study commissioned by the Department for Education (DfE) in 2013 to explore how childcare and early education can give children the best start in life and the factors which are important for the delivery of high quality provision.[6] The study is being undertaken by NatCen Social Research, the University of Oxford, Action for Children and Frontier Economics and is due to be completed in 2021. The aim of SEED is to provide a robust evidence base to inform the development of policy to improve children's readiness for school by:

- Providing evidence of the impact of current early years provision on children's outcomes and a basis for the longitudinal assessment of the impact on later attainment.
- Assessing the role and influence of the quality of early education provision on children's outcomes.
- Assessing the overall value for money of early education and the relative value for money associated with different types and quality of provision.
- Exploring how parenting and the home learning environment interacts with early years education in affecting children's outcomes.

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

- A longitudinal survey that initially included 5,642 families with pre-school children from the age of two to the end of key stage 1 (age seven).
- Around 1,000 visits to early years 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 the collection of cost data from 166 settings.
- Qualitative studies of childminders and of early education provision for children with special educational needs and disabilities.
- A study of experiences of the Early Years Pupil Premium.

[6] Further information about the SEED study can be found at http://www.seed.natcen.ac.uk/ and reports published to date are available at https://www.gov.uk/government/collections/study-of-early-education-and-development-seed.

This is the third report from the value for money component of SEED. The first report provided cost information for the delivery of early education (Blainey & Paull 2017), while the second presented estimates of the monetary value of potential impacts of early education at ages two and three on child outcomes at ages three, four and seven (Paull & Xu 2017). This report combines this information with the estimated impacts of early education on two measures of child development at ages three and four, presented in the Annex, to estimate the financial returns to early education spending from these impacts in the form of benefit-to-cost ratios (BCRs). The main body of the report was written by Frontier Economics, while the impact analysis presented in the Annex was undertaken by Edward Melhuish and Julian Gardiner. Later work in the value for money component of SEED will consider the longer-term financial returns using estimated impacts of early education at ages two and three on child outcomes at age seven.

The BCR is the value of the benefits divided by the cost. If this ratio is greater than one, the estimated value of the benefits exceeds the delivery cost. If the ratio is less than one, it shows the extent to which part of the cost of delivery is repaid in later benefits. This report compares the BCRs across different types of provision (part-time and full-time, provider type and quality of provision) and for children with different levels of disadvantage, indicating the types of provision offering the greatest potential return for each pound invested.

It is important to note that the estimated BCRs should not be treated as measures of absolute value for money but as indicators of the financial return to spending on different types of early education which arise from consequent improvements in children's verbal and socio-emotional development. In addition, there is no method to combine the BCRs for the two measures of child development as the impacts may be correlated and simple summation could potentially double count some of the benefits.

The following caveats should also be noted regarding the BCR estimates:

- The impact estimates underpinning the BCRs should be treated with caution because they only identify a causal impact to the extent that the control variables used in the impact analysis adequately control for other factors related to early education that may drive the outcomes.

- The impact estimates underpinning the BCRs should also be treated with caution because the comparison groups of children using no or no/low early education are very small (387 two-year-old children with no early education and 165 three-year-olds with no/low early education) and potentially atypical (that is, the small number of children using no or low early education may differ from children using some or more early education in ways that affect outcomes but are not captured in the survey measures).

- The BCRs may not capture the full value of the benefits of early education because the scope of SEED is limited to estimating the impacts on child

development and does not include other potential impacts such as on parental employment. In addition, limitations in the existing literature mean that only some measures of the potential impacts on child development could be valued. This needs to be balanced against the possibility that the value of the benefits may be overstated because the valuation of changes in child outcomes implicitly assumes that there is no “fade-out” in impact as the child ages.

- Due to insufficient information in the evidence sources, confidence intervals for the BCRs could not be estimated and there is no indication of the degree of confidence that the findings represent true differences in the population.

The remainder of this report is structured as follows:

- Chapter two describes the methodological approach used to estimate the BCRs.
- Chapter three presents the estimates of the cost of delivering early education.
- Chapter four presents the estimates of the impact of early education on child outcomes at ages three and four and the monetary value of these impacts.
- Chapter five combines the cost and value of impact estimates to present the BCRs for different types of provision and children.
- Chapter six provides a brief summary of the report.

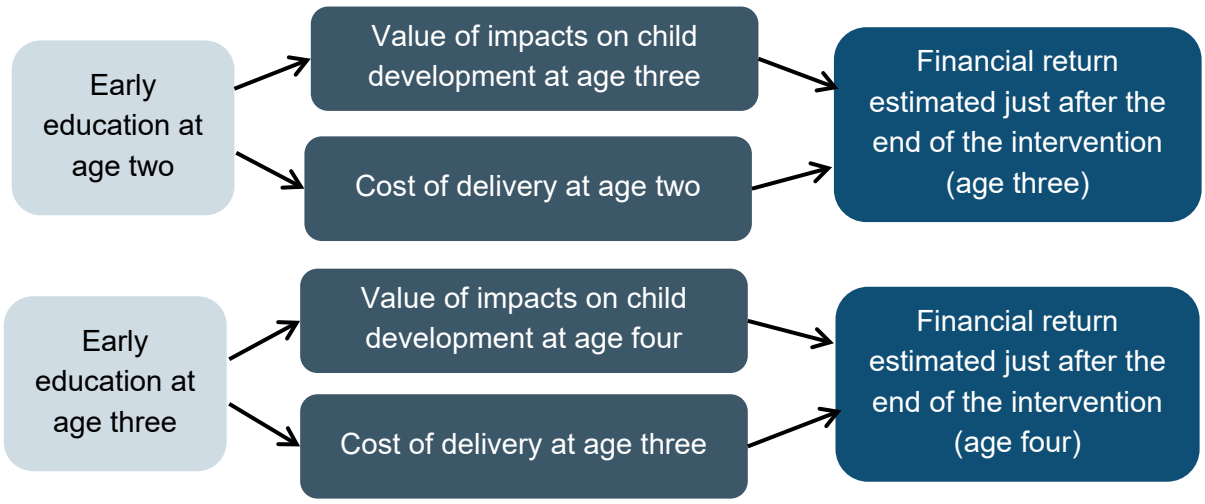
2. Methodology

This chapter presents the sources and methodology for estimating the financial returns to early education spending. It summarises the analysis framework (section 2.1) and defines the types of provision and outcome measures considered (sections 2.2 and 2.3). It also considers some important caveats to the estimated benefit-to-cost ratios (BCRs) and their interpretation (section 2.4).

2.1 Analysis framework

This report considers the financial returns to spending on early education received at age two and at age three,[7] comparing the value of the impacts measured just after the end of each year of early education relative to the cost of delivery. For early education at age two, this uses measures of outcomes when the child is aged three. For early education at age three, this uses outcomes when the child is aged four (just prior to school entry). This is summarised in figure 2.

Figure 2: Analysis framework



The BCRs were calculated using the following steps, drawing on two other SEED reports:

1. Estimation of the average hourly cost of delivery per child using data collected from settings in 2015 as part of the value for money component of SEED (Blainey & Paull 2017).

[7] Early education at age two is defined as that received between the child's second and third birthdays, while early education at age three is defined as that received between the child's third and fourth birthdays.

2. Estimation of the average annual hours of early education for different provision types and child disadvantage levels using data from the Longitudinal Survey of Families collected as part of the impact component of SEED.

3. Estimation of the average long-term private and government monetary value of the potential impacts using a review of existing literature sources undertaken as part of the value for money component of SEED (Paull & Xu 2017).

4. Estimation of the average impact of one year of early education on two child development outcomes using data from the Longitudinal Survey of Families collected as part of the impact component of SEED (undertaken by Edward Melhuish and Julian Gardiner with findings presented in the Annex).

5. Combining the findings from steps 1 and 2 to estimate the delivery cost per year of early education and combining the findings from steps 3 and 4 to estimate the value of the benefits per year of early education.

6. Calculation of the BCR as the value of the benefits per year of early education divided by the delivery cost per year of early education.

The BCRs were calculated for two outcomes (described below) at ages three and four. However, there is no method to combine the two as the impacts may be correlated and simple summation could potentially double count some of the benefits. Therefore, the BCRs for the two outcomes are considered separately.

2.2 Definitions of types of provision and child disadvantage

BCRs were estimated for all types of formal provision[8] and across three types of provision: part-time and full-time provision, provider type and setting quality.

The comparison of part-time and full-time provision is intended to be indicative of the differences between the universal free early education entitlement offering 15 hours each week for 38 weeks each year and the extended offer for three- and four-year-olds under 30 hours free childcare offering a total of 30 hours each week for 38 weeks each year. Because of the complexities of take-up of the free hours (either taken within school term time or spread across the year) and the differences in arrangements between term time and school holidays, an approximate measure of part-time and full-time was used based on the average weekly hours across the year for each child:

- Part-time is defined as average weekly hours of 15 or fewer.

[8] Use of informal provision, that provided by family and friends and not eligible for free entitlement funding, was included in the control variables for the impact analysis but is not part of this analysis.

- Full-time is defined as average weekly hours of more than 15.

In addition, as a comparison group of children with no early education was required for both age groups but almost all three-year-olds receive some early education, the "no/low early education" category was defined as average weekly hours of fewer than five for three-year-olds (while the category was defined as zero hours for age two).

The comparison between provider types was driven by the differences in hourly cost and outcomes in the findings in the earlier SEED reports. These differences are reflected in the consideration of three provider types:

- PVI, including private, voluntary and independent providers.[9]
- Maintained settings, including nursery classes in maintained schools, maintained nursery schools, local authority run settings and children's centres.[10]
- Childminders.[11]

The analysis of the quality of provision is only for group-based formal providers (not childminders). Quality is an age-specific measure based on the average of two measures (ITERS and SSTEW) for two-year-olds and on the average of three measures (ECERS-R, ECERS-E and SSTEW) for three-year-olds.[12] All the quality measures used a scale ranging from 1 to 7 and the average was divided into three discrete categories:

- Lower quality (<4.5)

[9] Private providers are defined as privately owned provision, including full day care and sessional care; ownership by an individual or by a larger organisation/chain; and that based on school sites and elsewhere. Voluntary providers are defined as provision run by a charity or voluntary management committee on a not-for-profit basis, including full day care and sessional care; unincorporated and incorporated (and registered with Charity Commission); and that based on school sites and elsewhere. Independent providers are defined as early years provision run by an independent school and delivered on site.

[10] Nursery classes are defined as a maintained early years class within a primary school with a qualified teacher present. Maintained nursery schools are defined as a maintained school, purpose built and specifically for children in their early years with a qualified teacher present. Local authority-run settings are defined as full day care or sessional provision delivered by the local authority with staff members employed by the local authority. Children's centres include those governed and managed in various ways by the local authority, by the school governing body (if on a school site), by a charity or by a private provider.

[11] Childminders are defined as a person whose job is to take care of other people's children in his or her own home.

[12] The Early Childhood Environment Rating Scale (ECERS-R) and its extension (ECERS-E) are designed to evaluate quality of provision for children aged 2½ to 5 years in centre-based settings. The Infant Toddler Environment Rating Scale (ITERS) is the partner scale for the 0 to 2½ years age range. Both the ECERS-R and ITERS-R contain a wide range of statements or "indicators" with which to evaluate the quality of the early years environment in its broadest sense. The Sustained Shared Thinking and Emotional Well-being (SSTEW) is a new scale which considers practice that supports children in developing skills in sustained shared thinking and emotional well-being, as well as developing strong relationships, effective communication and aspects of self-regulation. See Melhuish & Gardiner (2017) for further details.

- Medium quality (>=4.5 and <5.5)
- Higher quality (>=5.5)

The average weekly hours of provision were collected for each child from parents in the Longitudinal Survey of Families, while the provision type and quality for each setting used by the children were collected in matched visits to settings.

Each child in the study was categorised into one of three levels of disadvantage:[13]

- Most disadvantaged: the 20 percent most disadvantaged families including children with a parent in receipt of one of a number of benefits.[14]
- Moderately disadvantaged: the 20 to 40 percent most disadvantaged families including children with a parent in receipt of Working Tax Credits with household gross earnings of less than £16,190.
- The least disadvantaged: the 60 percent least disadvantaged families including children with parents *not* in receipt of any of the qualifying benefits or tax credits.

2.3 Child development measures

Two measures were used to capture potential impacts on the child's development:

1. The child's verbal development was measured using the naming vocabulary assessment from the British Ability Scale III (BAS), using direct assessments.
2. The child's socio-emotional development was measured as the total difficulties score from the Strengths and Difficulties Questionnaire (SDQ) reported by the early education provider at age three and by the parent at age four.[15]

The choice of these outcome measures was driven by a combination of the measures collected in the SEED study and the availability of evidence to link impacts on outcomes at this age to later lifetime outcomes which can be valued in monetary terms. Three other

[13] The Department for Work and Pensions (DWP) classified families into these groups prior to sampling based on circumstances when the child was two years old. The original sample aimed to sample equally from each of the three groups (that is, oversampled the two disadvantaged groups relative to their prevalence in the population).

[14] These benefits included Income-based Jobseeker's Allowance; Income-related Employment Support Allowance; Income Support (IS); Guaranteed Element of the State Pension Credit; or Child Tax Credit only (not in receipt of Working Tax Credit) with household gross earnings of less than £16,190.

[15] The subscales that comprise the SDQ total score are emotional symptoms (5 items); conduct problems (5 items); hyperactivity/inattention (5 items); peer relationship problems (5 items) and prosocial behaviour (5 items). The first four categories are added together to generate the total difficulties score (based on 20 of the 25 items).

measures collected in SEED at ages three and four were considered for inclusion in the value for money analysis, but have not been used for the following reasons:

- SEED included an additional BAS measure of picture similarities (a measure of non-verbal development and non-verbal reasoning), but this is not used here because the evidence linking BAS outcomes at ages three and four to later outcomes is only available for the naming vocabulary assessment.

- SEED included additional SDQ subscales for socio-emotional strengths, but these were not used here because the evidence linking SDQ outcomes at ages three and four to later outcomes is only available for the total difficulties score.

- SEED included an additional measure of self-regulation at age four in the "Heads, Toes, Knees and Shoulders" (HTKS) assessment, but this is not used here because there is little evidence linking HTKS at age four to later outcomes.

2.4 Caveats and interpretation of BCRs

It is important to note that the estimated BCRs should not be treated as measures of absolute value for money but as indicators of the financial return to spending on different types of early education which arise from consequent improvements in children's verbal and socio-emotional development. In addition, there is no method to combine the BCRs for the two measures of child development as the impacts may be correlated and simple summation could potentially double count some of the benefits.

The following caveats should also be noted regarding the BCR estimates.

Caveats 1 and 2 suggest that the impact estimates underpinning the BCRs should be treated with caution because of limitations in the data and methodology (see the Annex):

1) The estimates of impact identify a causal impact to the extent that the wide range of control variables used in the impact analysis adequately control for other factors related to early education that may drive the outcomes.

2) The comparison groups of no early education for two-year-olds contained only 387 children and of no/low early education (an average of less than five hours each week) for three-year-olds contained only 165 children (out of total samples of around 4,000). The comparison groups may also contain atypical children (that is, the small number of children using no or low early education may differ from children using some or more early education in ways that affect outcomes but are not captured in the survey measures). Together, these reduce the likelihood that statistically significant impacts of early education will be identified.

Caveats 3 and 4 suggest that the BCRs may not capture the full value of the benefits of early education:

3) The scope of SEED is limited to estimating the impacts of early education on child development and does not include other potential impacts, such as on child health outcomes, the home learning environment or parental employment (although some of these may be captured in the impacts on school achievement at age seven). Evidence on the impact of free part-time early education on parental employment suggests relatively small effects, although full-time early education may have stronger effects (Brewer et al. 2016; Paull & La Valle 2018).

4) Limitations in the existing literature mean that only some measures of the potential impacts on child development could be valued and that these valuations could not include a few later life outcomes which lacked adequate measures of monetary values. However, the effects of the absence of evidence on the value of links with later physical health and with intergenerational outcomes are unlikely to have led to large values of omitted benefits (see Paull & Xu 2017).

On the other hand, caveat 5 suggests that the value of the benefits may be overstated:

5) The valuation of changes in child outcomes implicitly assumes that there is no "fade-out" in impact as the child ages. That is, any initial impact is assumed to have the same impact on later outcomes as another factor currently driving variation in the initial outcome. This could lead to an overstatement of the value of the benefits, although this bias is mitigated to some extent by the use of regression analysis controlling for other influence in the underlying evidence sources (see Paull & Xu 2017).

Finally, caveat 6 means that there is no indication of the degree of confidence that the findings represent true differences in the population and they should be treated as indicative patterns:

6) The need to combine several different sources of information to estimate the BCRs means that it is not possible to estimate confidence intervals for the BCRs and to statistically test the differences in the estimated BCRs. The ratios are calculated from multiple estimated variables (including the hourly cost, the annual hours of use, the size of impacts, the associations between immediate and later outcomes and the monetary value of outcomes), which means that deriving the confidence intervals is not feasible because all the required information is not available (including the sampling variation for the monetary valuations and annual hours and the correlations in sampling variation between all the sources used in the calculation of the BCR). In addition, the resulting intervals would be too broad to be meaningful.

3. Delivery cost

This chapter presents the estimates of the hourly costs of delivery (section 3.1) and the annual hours of use for different types of provision and children (section 3.2). These are combined to present estimates of the annual cost which are used to calculate the BCRs (section 3.3).

The key findings are:

- The mean annual cost is considerably higher for full-time provision than part-time provision in direct proportion to the differences in the annual hours. This is because the hourly cost does not differ by part-time and full-time.
- With the exception of part-time provision for three-year-olds, the mean annual cost is higher for childminders than PVI and maintained providers, reflecting both a relatively higher hourly cost and higher annual hours. The mean annual cost is higher for maintained providers than for PVI providers because a higher hourly cost outweighs the effects of lower annual hours for maintained providers.
- For group-based providers, the mean annual cost does not vary to any substantial degree across the three quality levels for either age group, reflecting the absence of strong patterns in either the hourly cost or in annual hours across quality levels.
- The mean annual cost is highest for the least disadvantaged children and lowest for the most disadvantaged children. The differences are in direct proportion to the differences in the annual hours because the hourly cost estimates do not differ by child disadvantage level within each child age group.

3.1 Hourly costs

Data on delivery costs was collected during March to December 2015 from 160 settings using semi-structured face-to-face interviews. These settings were selected from a pool that had taken part in an earlier stage of SEED quality assessments. This meant that the cost data could be matched with the quality measures to derive estimates of the hourly cost for different quality levels. The timing of the data collection matched with the period during which the children in the SEED study were in early education. Further details on the data collection and cost estimates are available in Blainey & Paull (2017).[16]

[16] More recent estimates of hourly delivery costs based on data collected in March to July 2018 are available in Paull & Xu (2019).

Estimates of the hourly costs of delivery per child are presented for children aged two and for pre-school children aged three and four in tables 1 to 5.[17][18] The tables show that:

- The mean hourly cost for the younger age group (£4.30) is higher than for the older one (£3.72), while the median cost (the cost for the middle setting when settings are ranked from lowest to highest hourly cost) is lower than the mean for both age groups, indicating a small number of settings with notably higher costs (table 1).
- The mean hourly cost is notably (and statistically significantly) lower for PVI providers than for maintained providers and childminders with little (and no statistically significant) differences between the latter two types for both age groups (table 2 and table 3).
- For both age groups, the mean hourly cost has little variation across the three quality levels for group-based providers and there are no statistically significant differences in the mean hourly cost between any of the quality levels (table 4 and table 5).

Table 1: Hourly delivery cost per child by age of child

Age of child	Mean	95% confidence interval for mean	Median	Number of obs.
Two-year-olds	£4.30	£4.01 – £4.60	£3.96	140
Three- and four-year-old pre-school children	£3.72	£3.47 – £3.96	£3.32	158

Source: SEED Cost Study 2015

[17] Because sessions typically mix three-year-old and four-year-old pre-school children, the cost data has average hourly costs for both age groups rather than just three-year-olds, but this is the most accurate measure of the hourly cost for three-year-olds.

[18] These are partly drawn from Blainey & Paull (2017)) and from additional analysis of the underlying data. The report presents hourly costs for six provider types, but the data was re-analysed to generate the three more aggregated types to match the impact analysis. In addition, the median values and confidence intervals for the mean by quality level were derived for this report.

Table 2: Hourly delivery cost per child by provider type for two-year-olds

Hourly delivery cost	Mean	95% confidence interval for mean	Median	Number of obs.
PVI	£3.87	£3.65 – £4.10	£3.70	92
Maintained	£5.72	£4.78 – £6.67	£4.92	26
Childminders	£5.35	£4.17 – £6.53	£5.03	22

Source: SEED Cost Study 2015

Note: The mean hourly costs for maintained providers and childminders were statistically significantly higher than those for PVI providers (at the 99 percent level).

Table 3: Hourly delivery cost per child by provider type for three and four year old pre-school children

Hourly delivery cost	Mean	95% confidence interval for mean	Median	Number of obs.
PVI	£3.23	£3.04 – £3.42	£3.05	93
Maintained	£4.50	£3.91 – £5.10	£4.27	43
Childminders	£4.77	£3.83 – £5.72	£4.61	22

Source: SEED Cost Study 2015

Note: The mean hourly costs for maintained providers and childminders were statistically significantly higher than those for PVI providers (at the 99 percent level).

Table 4: Hourly delivery cost per child by quality level for two-year-olds

Hourly delivery cost	Mean	95% confidence interval for mean	Median	Number of obs.
Lowest quality	£3.98	£3.49 – £4.47	£3.71	37
Middle quality	£4.07	£3.59 – £4.55	£3.93	32
Highest quality	£4.04	£3.53 – £4.55	£3.77	33

Source: SEED Cost Study 2015

Note: There were no statistically significant differences in the mean hourly cost across the three quality levels. The sample includes only group-based providers (no childminders).

Table 5: Hourly delivery cost per child by quality level for three and four year old pre-school children

Hourly delivery cost	Mean	95% confidence interval for mean	Median	Number of obs.
Lowest quality	£3.47	£3.14 – £3.80	£3.29	48
Middle quality	£3.34	£2.99 – £3.69	£3.05	38
Highest quality	£3.66	£3.17 – £4.15	£3.08	36

Source: SEED Cost Study 2015

Note: There were no statistically significant differences in the mean hourly cost across the three quality levels. The sample includes only group-based providers (no childminders).

3.2 Annual hours

In order to calculate annual costs, information was required on the annual hours of early education. This information was derived from the SEED Longitudinal Survey of Families, which collected data from 3,930 families on the hours of early education used each year with each provider, which could be matched into information on provider type and setting quality from other elements of SEED.[19]

Tables 6 to 9 present the average annual hours of early education by child age for all providers and by provider type, setting quality and child disadvantage level. With the exception of child disadvantage, these are divided into part-time and full-time. For three-year-olds, the annual hours are the differences between the observed mean annual hours for those in part-time and those in full-time and the mean annual hours for the comparison low-use group (84 hours). For two-year-olds, the comparison group of no early education has mean annual hours of zero and the presented numbers are the observed annual mean hours for two-year-olds in part-time and full-time early education.

Tables 6 to 9 show that:

- For two-year-olds, the average annual hours for children in full-time early education is more than three times greater than that for children in part-time early education. This reflects that these children either use more hours within each week and/or are in early education for more weeks each year (or both). For three-

[19] Because collection of quality information was only undertaken for a selection of group-based settings used by families in the survey, hours information by quality level was only available for 1,258 families reporting on early education when the child was aged two and 1,260 families reporting on early education when the child was aged three.

year-olds, the average annual hours for children in full-time is just over twice that for children in part-time.

- Mean hours at maintained providers are generally lower than those at PVI providers and childminders, although the differences are not large. The main difference across provider types is that three-year-old children using part-time early education have notably lower hours with childminders than those with other provider types. This may reflect low numbers of hours with childminders for three-year-olds who also take their 15-hour free early education entitlement in a group-based setting.

- There are no distinctive patterns in the mean hours by the quality of provider.

- Mean hours are highest for the least disadvantaged children and lowest for the most disadvantaged children for both age groups, reflecting that less-disadvantaged children are more likely to have all parents in work and to consequently spend more time in early education provision.

Table 6: Annual hours of early education for all providers

Mean annual hours (relative to no early education group for two-year-olds and relative to no/low early education group for three-year-olds)	**Two-year-olds Part-time**	**Two-year-olds Full-time**	**Three-year-olds Part-time**	**Three-year-olds Full-time**
All providers	264	966	368	789

Source: SEED Longitudinal Survey of Families

Notes: For three-year-olds, the annual hours are the differences between the observed mean annual hours for those in part-time and those in full-time and the mean annual hours for the comparison low-use group (84 hours). For two-year-olds, the comparison group of no early education has mean annual hours of zero and the presented numbers are the observed annual mean hours for two-year-olds in part-time and full-time early education. The cell sample sizes are 2,893, 1,303, 1,570 and 2,195.

Table 7: Annual hours of early education by provider type

Mean annual hours (relative to no early education group for two-year-olds and relative to no/low early education group for three-year-olds)	Two-year-olds Part-time	Two-year-olds Full-time	Three-year-olds Part-time	Three-years-olds Full-time
PVI	268	952	353	775
Maintained	223	820	354	674
Childminders	263	975	154	833

Source: SEED Longitudinal Survey of Families

Notes: For three-year-olds, the annual hours are the differences between the observed mean annual hours for those in part-time and those in full-time and the mean annual hours for the comparison low-use group (84 hours). For two-year-olds, the comparison group of no early education has mean annual hours of zero and the presented numbers are the observed annual mean hours for two-year-olds in part-time and full-time early education. The cell sizes range from 97 to 2,205 with a mean value of 720.

Table 8: Annual hours of early education by setting quality

Mean annual hours (relative to no early education group for two-year-olds and relative to no/low early education group for three-year-olds)	Two-year-olds Part-time	Two-year-olds Full-time	Three-year-olds Part-time	Three-year-olds Full-time
Lowest	352	942	379	737
Middle	341	872	367	735
Highest	320	920	368	730

Source: SEED Longitudinal Survey of Families

Notes: For three-year-olds, the annual hours are the differences between the observed mean annual hours for those in part-time and those in full-time and the mean annual hours for the comparison low-use group (84 hours). For two-year-olds, the comparison group of no early education has mean annual hours of zero and the presented numbers are the observed annual mean hours for two-year-olds in part-time and full-time early education. The cell sizes range from 104 to 280 with a mean value of 164.

Table 9: Annual hours of early education by child disadvantage group

Mean annual hours (relative to no early education group for two-year-olds and relative to no/low early education group for three-year-olds)	Two-year-olds	Three-year-olds
Most disadvantaged	412	559
Moderately disadvantaged	485	612
Least disadvantaged	526	648

Source: SEED Longitudinal Survey of Families

Notes: For three-year-olds, the annual hours are the differences between the observed mean annual hours for those in part-time and those in full-time and the mean annual hours for the comparison low-use group (84 hours). For two-year-olds, the comparison group of no early education has mean annual hours of zero and the presented numbers are the observed annual mean hours for two-year-olds in part-time and full-time early education. The cell sizes range from 899 to 1,630 with a mean value of 1,327.

3.3 Annual costs

Tables 10 to 13 combine the information from the previous two sections to present the estimated average annual costs of early education by provider type and quality and child disadvantage level. These are calculated as the hourly cost multiplied by the average annual number of hours used by children. These numbers are used as the denominators in the calculation of the BCRs.

Tables 10 to 13 show that:

- The mean annual cost is considerably higher for full-time provision than part-time provision in direct proportion to the differences in the annual hours for both age groups because the hourly cost does not differ by part-time and full-time.[20]
- With the exception of part-time provision for three-year-olds, the mean annual cost is highest for childminders, reflecting both a relatively higher hourly cost and higher annual hours. The mean annual cost is higher for maintained providers than for PVI providers because a higher hourly cost outweighs the effects of lower annual hours for maintained providers. For part-time provision for three-year-olds,

[20] It was not possible to separately estimate the hourly cost for part-time and full-time provision in the cost study.

the low annual hours mean than the annual cost is notably lower for childminders than other provider types.

- The mean annual cost does not vary to any substantial degree across the three quality levels for either age group, reflecting the absence of strong patterns in either the hourly cost or in annual hours across quality levels.
- The mean annual cost is highest for the least disadvantaged children and lowest for the most disadvantaged children in direct proportion to the differences in the annual hours for both age groups because the hourly cost does not differ by child disadvantage level.[21]

Table 10: Annual delivery cost for all providers

Mean annual delivery cost	Two-year-olds Part-time	Two-year-olds Full-time	Three-year-olds Part-time	Three-year-olds Full-time
All providers	£1,135	£4,153	£1,369	£2,935

Note: Costs are for 2015.

Table 11: Annual delivery cost by setting type

Mean annual delivery cost	Two-year-olds Part-time	Two-year-olds Full-time	Three-year-olds Part-time	Three-year-olds Full-time
PVIs	£1,038	£3,682	£1,141	£2,502
Maintained	£1,276	£4,701	£1,594	£3,040
Childminders	£1,404	£5,218	£736	£3,975

Note: Costs are for 2015.

[21] It was not possible to separately estimate the hourly cost across different types of children in the cost study.

Table 12: Annual delivery cost by setting quality

Mean annual delivery cost	Two-year-olds Part-time	Two-year-olds Full-time	Three-year-olds Part-time	Three-year-olds Full-time
Lowest	£1,401	£3,749	£1,315	£2,557
Middle	£1,388	£3,549	£1,226	£2,455
Highest	£1,293	£3,717	£1,347	£2,672

Note: Costs are for 2015.

Table 13: Annual delivery cost by child disadvantage group

Mean annual delivery cost	Two-year-olds	Three-year-olds
Most disadvantaged	£1,772	£2,078
Moderately disadvantaged	£2,085	£2,275
Least disadvantaged	£2,262	£2,410

Note: Costs are for 2015.

4. Value of impacts on child development

This chapter presents the monetary valuations of changes in the child development measures (section 4.1) and the estimated impacts for different types of provision and children (section 4.2). These are combined to present estimates of the value of the benefits which are used to calculate the BCRs (section 4.3).

It should be noted that the estimated impacts presented in section 4.2 are drawn from more restricted analysis than the broader range of outcomes and model specifications reported in Melhuish et al. (2017) and Melhuish & Gardiner (2018). Full details of the impact analysis used here are presented in the Annex.

The key findings are:

- The monetary value of similar-sized improvements in the verbal development and socio-emotional development measures at age three or age four are quite similar: a change in these outcomes of one standard deviation is estimated to have a value of around £8,000. The key driver of this financial return is higher earnings rather than reductions in the costs of government services, with the benefits mainly accruing to individuals and around one-third accruing to the government.

- Part-time and full-time early education at age two are associated with positive impacts on verbal development measured at age three, but there is no strong evidence of similar positive impacts for early education at age three on verbal development measured at age four or for socio-emotional development for early education at either age.

- For two-year-olds in full-time early education, the impacts on verbal development at age three are higher for childminders than for other provider types. The evidence does not indicate any consistent associations between quality level and either development measure for early education at either age.

- The positive impacts on child development for early education at both ages are higher for those in the moderately and least disadvantaged groups than for those in the most disadvantaged groups.

- The estimated value of the benefits from improvements in verbal development are £1,233 for part-time early education and £1,706 for full-time early education at age two and £157 for part-time early education and £577 for full-time early education at age three. The estimated value of the benefits from improvements in socio-emotional development are considerably smaller, reflecting the differences in size of impact rather than the monetary value of impact.

4.1 Valuation of changes in outcomes

The estimates of the value of the impacts on verbal development and socio-emotional development at ages three and four were drawn from the earlier SEED report on the potential value for money (Paull & Xu 2017). This study estimated the values in three steps:

- Estimation of the links between the measures for verbal development and socio-emotional development at ages three and four and later lifetime outcomes for which estimates of monetary value could be derived using existing evidence.
- Estimation of the monetary value of changes in later lifetime outcomes, including the amounts accruing to individuals, to the government and to society more broadly.
- Combining the links and monetary values of final outcomes to derive an estimate of the total lifetime value of a one standard deviation improvement in each initial outcome, discounted to 2015 to match the timing of the delivery cost estimates.[22]

Further details on the impact analysis are presented in Paull & Xu (2017), but the key caveats are summarised in chapter 2.

Table 14 presents a summary of the valuations. It shows that:

- The values of similar-sized improvements in the verbal development and socio-emotional development measures at ages three or four are quite similar: a change in these outcomes of a standard deviation is estimated to have a lifetime monetary value of around £8,000. Such changes correspond to around 17 points on the BAS scale (which ranges from 10 to 141) or around 5 points on the SDQ scale (which ranges from 0 to 40).
- Around one-third of the value of a change in the verbal development and socio-emotional development measures at both ages accrues to the government. Hence, the government BCRs (defined as the ratio of benefit to the government to total cost) would be one-third of the ratios for the total BCR (defined as the ratio of total benefit to total cost).

[22] The standard deviation was used because much of the literature presented links in terms of associations in standard deviations. In addition, use of the standard deviation means that the value of a similar size of impact can be compared across outcomes with different metrics. The standard deviation is a measure of the variation in the outcome and 68 percent of cases typically have a value which lies within one standard deviation of the mean. This means that an impact of one standard deviation is generally considered to be a large change.

Table 14: Valuations of improvements in child development

Value of a one standard deviation improvement in child development	Verbal outcomes at age three	Socio-emotional outcomes at age three	Verbal outcomes at age four	Socio-emotional outcomes at age four
Government value	£2,781	£2,303	£2,881	£2,386
Private value	£5,695	£4,381	£5,900	£4,539
Social value	- £32	£119	- £33	£123
Total value	£8,444	£6,803	£8,748	£7,048

Source: Paull & Xu (2017)

Notes: Private value indicates benefits or costs accruing to private individuals (the children experiencing early education); government value indicates those accruing to the government through increased revenues or reduced spending on services other than early education; and social value indicates those accruing to society more broadly (other individuals who did not use the early education). Improvements correspond to an increase in the BAS verbal development score and a decrease in the SDQ total difficulties score.

As shown in Paull & Xu (2017), the key driver of the monetary value of the returns is higher earnings rather than reductions in the costs of government services and the benefits mainly accrue to individuals. This is partly because the links to later employment and earnings tend to be stronger than to other later lifetime outcomes. But it is primarily due to the fact that a small impact on earnings operates on high annual amounts for a large number of years for most individuals, while impacts which reduce “problem” outcomes (such as special educational needs, truancy, school exclusion, crime, smoking and depression) have an effect on a much smaller number of individuals over fewer years and with lower annual amounts involved.

4.2 Estimated impacts

The impact analysis used data from the SEED Longitudinal Survey of Families for 3,930 families from three points in time when the target child was aged two years, three years and four years (just prior to entry into school reception class at a mean age of four years and four months). Information on the use of early education, child outcomes at ages three and four and a wide range of demographic background data was collected. The sampling approach oversampled families who were most disadvantaged and moderately disadvantaged to ensure sufficient sample sizes for separate analysis of these families.

Further details on the impact analysis are presented in the Annex, but the key caveats are summarised in chapter 2.

A summary of the impacts (measured in standard deviations) is presented in tables 15 to 18. The tables show:

- For all providers and all children, the largest (and statistically significant) impacts are on verbal development measured at age three for children in full-time and part-time early education at age two. There are no notable impacts for socio-emotional development for early education at age two or for either measure of development for early education at age three.

- Both part-time and full-time early education with each of the three provider types is associated with positive impacts on verbal development, although the impacts are larger for two-year-olds with childminders than for those with other provider types. There are no notable effects on socio-emotional development for any of the three provider types.

- There are no indications of any strong associations between quality level and either child development measure.[23]

- There are positive impacts on verbal development for both the moderately and least disadvantaged groups, which are largest for the least disadvantaged groups for early education at both ages. There are also positive impacts on socio-emotional development for the moderately disadvantaged and least disadvantaged groups, but these are largest for the moderately disadvantaged for early education at both ages.[24]

[23] This may be surprising in light of the evidence cited in Melhuish & Gardiner (2018) on the importance of quality for child development using other measures of outcomes. The comparisons between quality and impact are considered in more detail in the Annex.

[24] These differences in impacts could reflect differences in the hours of early education and provider type used by children with different levels of disadvantage. However, including controls for the hours of early education or the type of provider in the estimation of the impacts generated a broadly similar picture, indicating that the differences in returns are not due to the variation in hours of use or provider type across children with different levels of disadvantage. See the Annex for further details.

Table 15: Estimated impacts of early education for all providers and all children

Improvements in child development in standard deviations	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to no/low early education	Socio-emotional outcomes at age four for early education at age three relative to no/low early education
Part-time	0.146 ***	0.006	0.018	- 0.032
Full-time	0.202 ***	0.078	0.066	- 0.004

Source: Analysis by Edward Melhuish & Julian Gardiner presented in the Annex

Notes: Stars denote a statistically significant difference with no or no/low early education at the 5% level (**) and 1% level (***). Improvements correspond to an increase in the BAS verbal development score and a decrease in the SDQ total difficulties score. Low early education is defined as an average of less than five hours per week.

Table 16: Estimated impacts of early education by provider type

Improvements in child development in standard deviations	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to no/low early education	Socio-emotional outcomes at age four for early education at age three relative to no/low early education
Part-time – PVI	0.103 ***	- 0.041	0.145 ***	- 0.034
Part-time – maintained	0.067	- 0.017	0.140 **	- 0.141 ***
Part-time – childminders	0.138 **	0.071	0.110 **	0.058
Full-time – PVI	0.117 **	0.103 **	0.145 **	- 0.031
Full-time – maintained	0.223 **	- 0.057	0.169 **	- 0.025
Full-time – childminders	0.266 ***	0.051	0.115	0.038

Source: Analysis by Edward Melhuish & Julian Gardiner presented in the Annex

Notes: Stars denote a statistically significant difference with no or no/low early education at the 5% level (**) and 1% level (***). Improvements correspond to an increase in the BAS verbal development score and a decrease in the SDQ total difficulties score. Low early education is defined as an average of less than five hours per week.

Table 17: Estimated impacts of early education by quality of setting (group-based providers)

Improvements in child development in standard deviations	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to no/low early education	Socio-emotional outcomes at age four for early education at age three relative to no/low early education
Part-time – lowest quality	0.264 ***	0.039	0.073	- 0.043
Part-time – middle quality	0.260 ***	- 0.087	0.121	- 0.013
Part-time – highest quality	0.210 **	0.131	0.160	- 0.063
Full-time – lowest quality	0.131	0.133	0.135	0.049
Full-time – middle quality	0.248 ***	0.124	0.070	0.031
Full-time – highest quality	0.179	0.143	0.040	0.057

Source: Analysis by Edward Melhuish & Julian Gardiner presented in the Annex

Notes: Stars denote a statistically significant difference with no or no/low early education at the 5% level (**) and 1% level (***). Improvements correspond to an increase in the BAS verbal development score and a decrease in the SDQ total difficulties score. Low early education is defined as an average of less than five hours per week.

Table 18: Estimated impacts of early education by child disadvantage level

Improvements in child development in standard deviations	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to no/low early education	Socio-emotional outcomes at age four for early education at age three relative to no/low early education
Most disadvantaged	- 0.014	- 0.009	- 0.047	- 0.182
Moderately disadvantaged	0.176 **	0.073	0.093	0.113
Least disadvantaged	0.306 ***	0.008	0.125	0.026

Source: Analysis by Edward Melhuish & Julian Gardiner presented in the Annex

Notes: Stars denote a statistically significant difference with no or no/low early education at the 5% level (**) and 1% level (***). Improvements correspond to an increase in the BAS verbal development score and a decrease in the SDQ total difficulties score. Low early education is defined as an average of less than five hours per week.

4.3 Value of estimated impacts

Tables 19 to 22 combine the valuations of changes in outcomes from section 4.1 and the estimated impacts from section 4.2 to present the estimated value of the impacts for the two outcome measures and two age groups. These numbers are used as the numerators in the calculation of the BCRs.

Table 19: Value of estimated impacts of early education for all providers and all children

Value of impacts on child development	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to no/low early education	Socio-emotional outcomes at age four for early education at age three relative to no/low early education
Part-time	£1,233	£41	£157	- £226
Full-time	£1,706	£513	£577	- £28

Note: Values are total lifetime benefits discounted to 2015.

Table 20: Value of estimated impacts of early education by provider type

Value of impacts on child development	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to no/low early education	Socio-emotional outcomes at age four for early education at age three relative to no/low early education
Part-time – PVI	£870	-£279	£1,268	- £240
Part-time – maintained	£566	-£116	£1,225	- £994
Part-time – childminders	£1,165	£483	£962	£409
Full-time – PVI	£988	£701	£1,268	- £218
Full-time – maintained	£1,883	- £388	£1,478	- £176
Full-time – childminders	£2,246	£347	£1,006	£268

Note: Values are total lifetime benefits discounted to 2015.

Table 21: Value of estimated impacts of early education by quality of setting

Value of impacts on child development	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to low early education	Socio-emotional outcomes at age four for early education at age three relative to low early education
Part-time – lowest quality	£2,229	£265	£639	- £303
Part-time – middle quality	£2,195	- £592	£1,059	- £92
Part-time – highest quality	£1,773	£891	£1,400	- £444
Full-time – lowest quality	£1,106	£905	£1,181	£345
Full-time – middle quality	£2,094	£826	£612	£218
Full-time – highest quality	£1,511	£973	£350	£402

Note: Values are total lifetime benefits discounted to 2015.

Table 22: Value of estimated impacts of early education by child disadvantage level

Value of impacts on child development	Verbal outcomes at age three for early education at age two relative to no early education	Socio-emotional outcomes at age three for early education at age two relative to no early education	Verbal outcomes at age four for early education at age three relative to low early education	Socio-emotional outcomes at age four for early education at age three relative to low early education
Most disadvantaged	- £118	- £61	- £411	- £1,283
Moderately disadvantaged	£1,486	£497	£814	£796
Least disadvantaged	£2,584	£54	£1,094	£183

Note: Values are total lifetime benefits discounted to 2015.

The estimated value of the benefits from improvements in verbal development are £1,233 for part-time early education and £1,706 for full-time early education at age two, and £157 for part-time early education and £577 for full-time early education at age three. Given that the monetary value of similar-sized impacts for the two measures and both age groups are very similar, it is not surprising that the pattern of the value of the impacts closely mirrors the impact findings:

- With only two exceptions, the value derived from the impact on verbal development is greater (and typically substantially greater) than the value derived from the impact on socio-emotional development.
- In most cases, the value of the impacts on verbal development are higher for early education for two-year-olds than for three-year-olds. The main exception to this is when part-time early education is considered by provider type.
- Within each column, the patterns are proportional to the impact estimates because the same monetary valuation is applied to all impacts to calculate the value of the benefits.

5. Benefit-to-cost ratios

This chapter presents the benefit-to-cost ratios (BCRs) for the impacts on child development for different types of early education and children. The chapter begins with essential guidance on understanding and interpreting the BCRs (section 5.1) before presenting the BCRs for part-time and full-time early education for all types of providers and children (section 5.2). The remainder of the chapter explores the variation in the BCRs by provider type (section 5.3), by setting quality (section 5.4) and across children with different levels of disadvantage (section 5.5).

The key findings are:

- The greatest returns operate through the impacts on verbal development rather than on socio-emotional development.
- The BCRs are notably higher for early education at age two than for early education at age three, driven by larger impacts outweighing the higher delivery cost for early education at age two.
- The BCRs using the verbal development measure are higher for part-time than full-time for two-year-olds because the annual cost is so much lower for part-time, while there is little difference in the value of the impact. However, the BCRs using the socio-emotional development measure for early education at age two and the BCRs using both verbal and socio-emotional development for early education at age three are slightly higher for full-time than part-time because the substantially higher impacts outweigh the higher cost for full-time.
- The BCRs are generally higher for childminders than for the other provider types, primarily reflecting larger impacts rather than lower costs. The pattern between PVI and maintained providers is more mixed, mainly driven by the mixed pattern in the impacts.
- There is no consistent pattern in the BCRs across setting quality levels, reflecting the absence of strong associations between cost or impacts and quality. This could be due to insufficient variation in quality (particularly in the proportion of settings with lower quality) to identify any clear patterns.[25]
- The BCRs are higher for children in the moderately and least disadvantaged groups than those in the most disadvantaged group: the higher annual costs are outweighed by the higher impacts for children in the moderately and least disadvantaged groups.

[25] The associations between quality and impact are considered in more detail in the Annex.

5.1 Interpretation of BCRs

The BCRs were calculated as the estimated lifetime monetary value of the impact on verbal development or socio-emotional development associated with one year of early education, divided by the corresponding estimated annual delivery cost. BCRs can be interpreted as follows:

- A BCR estimate that is **greater than one** implies that the value of the impacts on verbal development or socio-emotional development exceeds the delivery cost.
- A BCR estimate **between zero and one** implies that the value of the impacts on verbal development or socio-emotional development is less than the delivery cost.
- A BCR estimate that is **less than zero** implies that there is a negative or detrimental impact on verbal development or socio-emotional development.

As highlighted in section 4.1, roughly one-third of the value of any impact is estimated to accrue to the government and two-thirds to private individuals. Hence, the government BCRs (defined as the ratio of benefit to the government to total cost) would be one-third of the ratios presented below.

It is important to note that the estimated BCRs should not be treated as measures of absolute value for money but as indicators of the financial return to spending on different types of early education which arise from consequent improvements in children's verbal and socio-emotional development. In addition, there is no method to combine the BCRs for the two measures of child development as the impacts may be correlated and simple summation could potentially double count some of the benefits.

The following caveats should also be noted regarding the BCR estimates:

- The impact estimates underpinning the BCRs should be treated with caution because they only identify a causal impact to the extent that the control variables used in the impact analysis adequately control for other factors related to early education that may drive the outcomes.
- The impact estimates underpinning the BCRs should also be treated with caution because the comparison groups of children using no or no/low early education are very small (387 two-year-old children with no early education and 165 three-year-olds with no/low early education) and potentially atypical (that is, the small number of children using no or low early education may differ from children using some or more early education in ways that affect outcomes but are not captured in the survey measures).
- The BCRs may not capture the full value of the benefits of early education because the scope of SEED is limited to estimating the impacts on child development and does not include other potential impacts such as on parental

employment. In addition, limitations in the existing literature mean that only some measures of the potential impacts on child development could be valued. This needs to be balanced against the possibility that the value of the benefits may be overstated because the valuation of changes in child outcomes implicitly assumes that there is no "fade-out" in impact as the child ages.

- Due to insufficient information in the evidence sources, confidence intervals for the BCRs could not be estimated and there is no indication of the degree of confidence that the findings represent true differences in the population.

5.2 BCRs by part-time and full-time

Figure 3 presents the estimated BCRs for part-time and full-time early education for all provider types and children.

Figure 3: BCRs by part-time and full-time early education

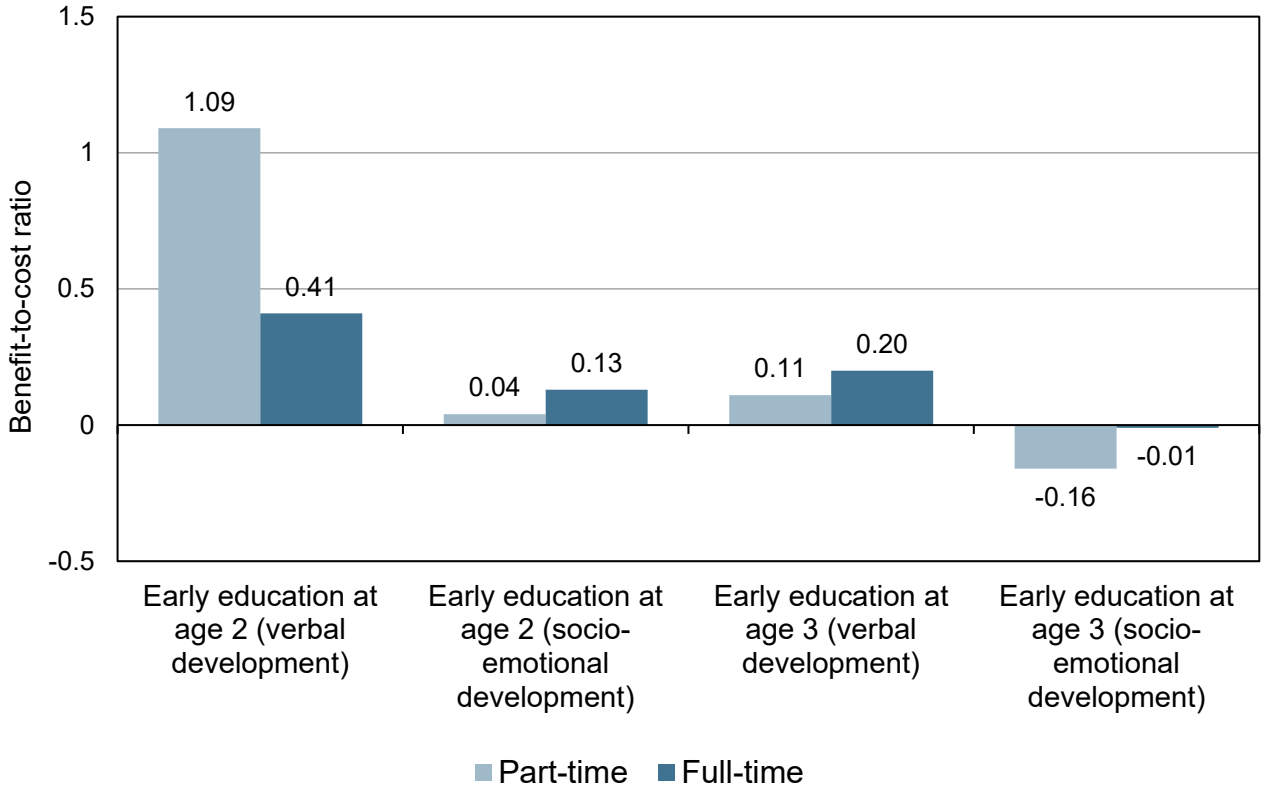


Figure 3 shows that:

- The BCR is greater than one for verbal development for two-year-olds in part-time early education, indicating that the value of the improvement in verbal development exceeds the delivery cost for part-time early education for two-year-olds.

- The BCR is 0.41 for verbal development for two-year-olds in full-time early education, indicating that the value of the improvement in verbal development repays just under half of the delivery cost for part-time early education for two-year-olds.
- The BCR is 0.11 and 0.20 for verbal development for three-year-olds in part-time and full-time early education respectively, indicating that the value of the improvement in verbal development pays back a small part of the delivery cost for early education for three-year-olds.
- The BCR for socio-emotional development is small or negative for both part-time and full-time early education for both age groups, indicating that little of the cost of early education is recuperated through improvements in socio-emotional development.

The figure also highlights the relative financial returns across age groups and quantity of early education:

- The greatest returns operate through verbal development rather than socio-emotional development. This is driven by the estimates of larger impacts for the verbal development measure than for the socio-emotional development measure.
- The BCRs are notably higher for early education at age two than for early education at age three, driven by larger impacts which are not outweighed by a higher delivery cost for early education at age two.
- The BCRs using the verbal development measure are higher for part-time than full-time for two-year-olds because the annual cost is so much lower, while there is little difference in the value of the impact. However, the BCRs using the socio-emotional development measure for two-year-olds and the BCRs using both verbal and socio-emotional development for three-year-olds are slightly higher for full-time than part-time because the substantially higher impacts outweigh the higher cost for full-time.

5.3 BCRs by provider type

Figures 4 and 5 present the estimated BCRs by provider type.

Figure 4: BCRs by provider type for early education at age two

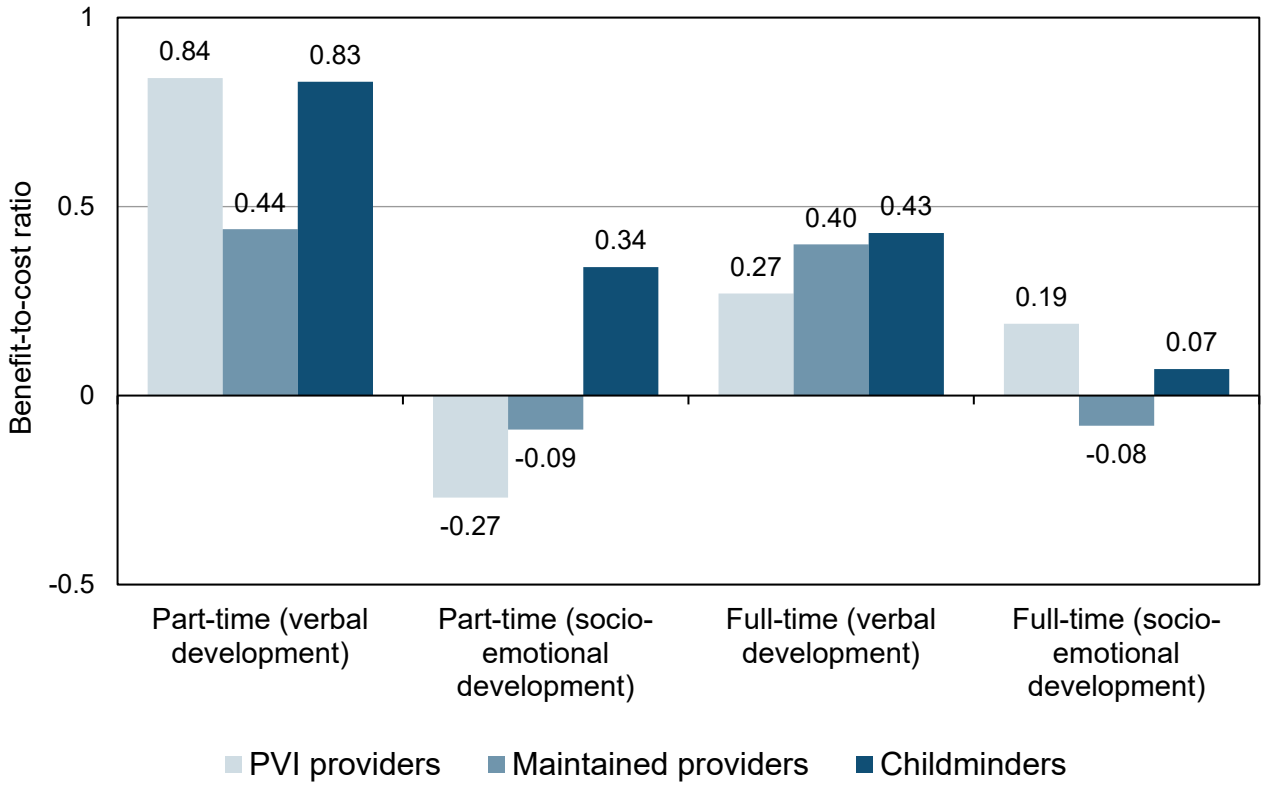
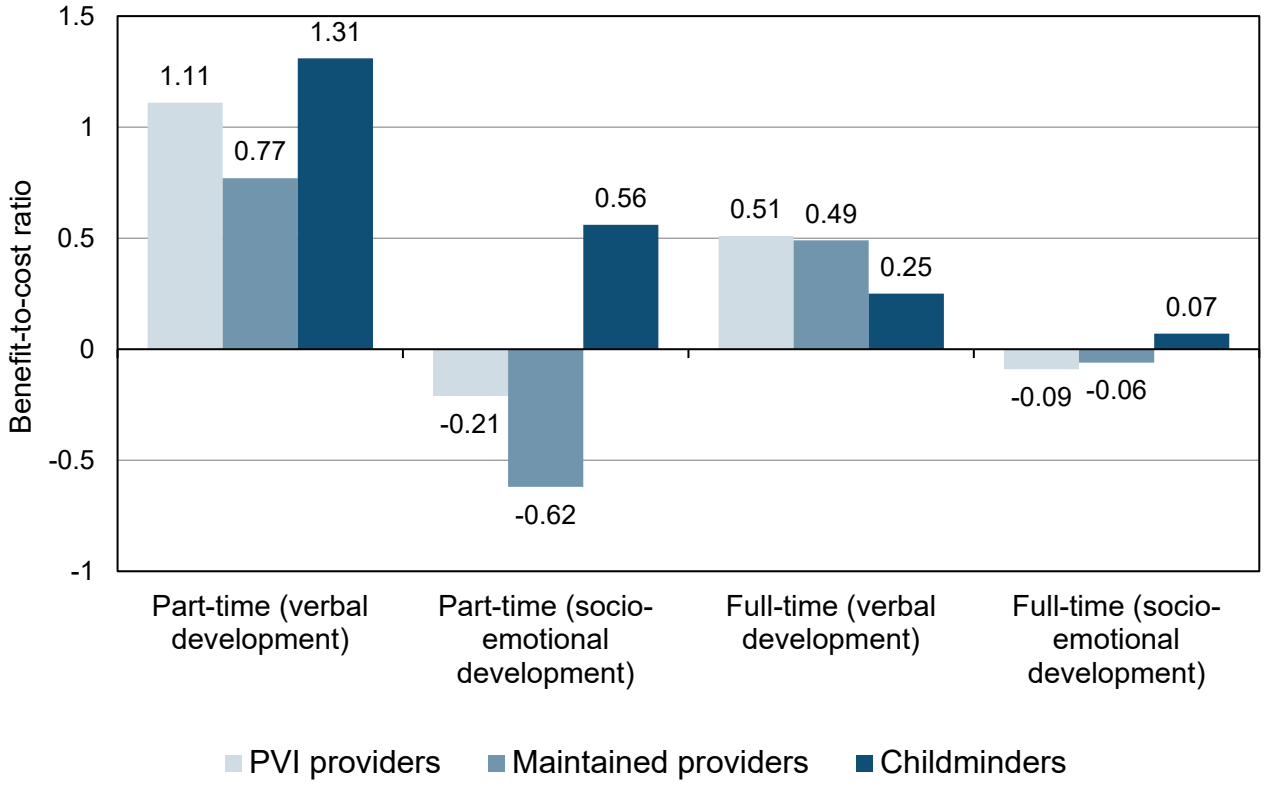


Figure 5: BCRs by provider type for early education at age three



Figures 4 and 5 show that:

- For early education at both ages, the largest BCRs are for verbal development for part-time early education with PVI providers and childminders. The estimated BCRs are over one for three-year-olds, suggesting that the financial return from the improvement in verbal development outweighs the delivery cost.
- For early education at both ages, there are substantial returns via improvements in verbal development for part-time early education with maintained providers and for full-time care with all provider types.
- For early education at both ages, the only substantial return via improvement in socio-emotional development is for part-time care with childminders.

These patterns are driven primarily by the lower annual costs for part-time over full-time and by the higher impacts for verbal development than the socio-emotional development.

The figures show some negative BCRs using the socio-emotional development measure:

- The positive BCRs for early education at age two in figure 2 masks the mixture of positive and negative BCRs across provider types shown in figure 3: for PVI providers, the association with poorer socio-emotional development for part-time early education means that the BCR is negative, while the same pattern can also be seen for maintained providers for both part-time and full-time.
- Similarly, the positive BCR for full-time early education at age three in figure 2 masks the negative BCRs for PVI and maintained providers in figure 4, while the negative BCR for part-time early education seen in figure 2 is driven by the associations with poorer development for PVI and maintained providers.

The BCRs are generally higher for childminders than the other provider types, primarily reflecting larger impacts rather than lower costs. The pattern between PVI and maintained providers is more mixed (PVI have a higher BCR in half the cases and, maintained providers have a higher BCR in the other half), mainly driven by the mixed pattern in the impacts.

5.4 BCRs by setting quality

Figures 6 and 7 present the estimated BCRs by setting quality for group-based providers.

Figure 6: BCRs by setting quality for early education at age two

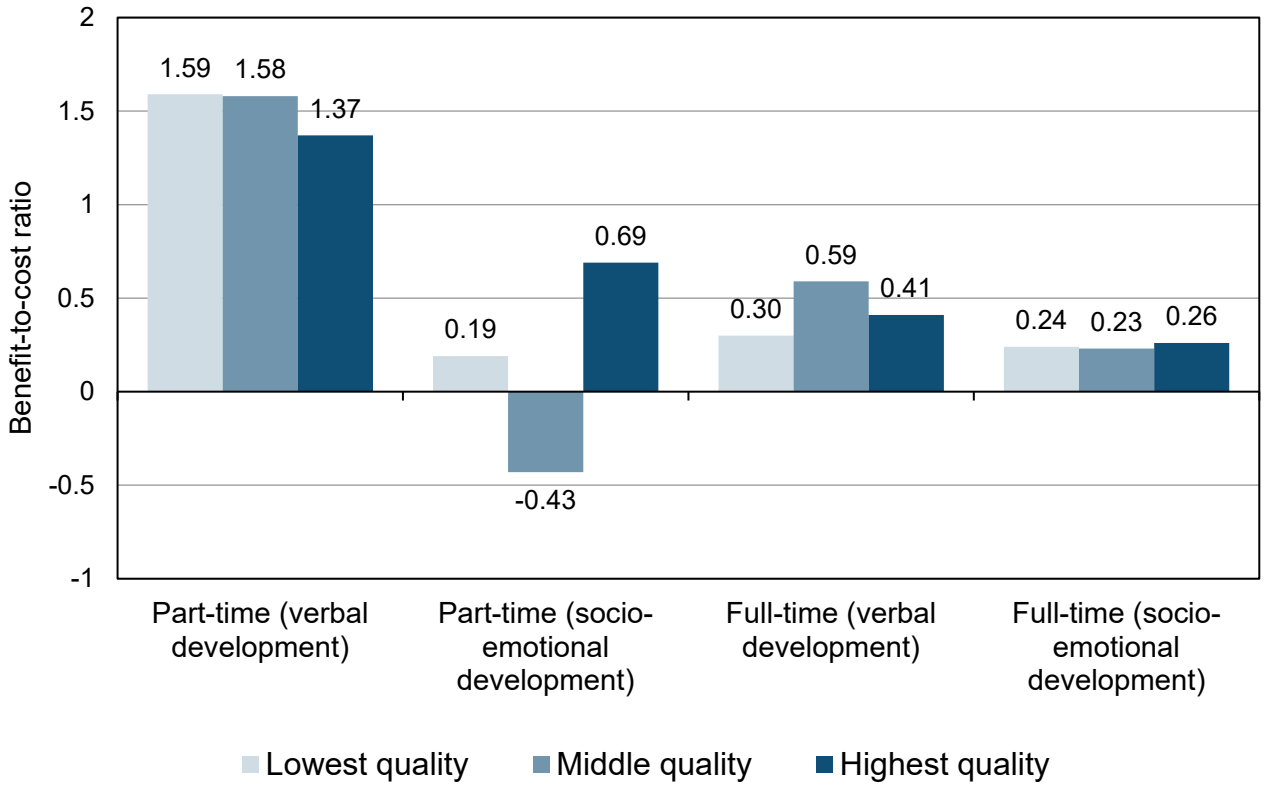
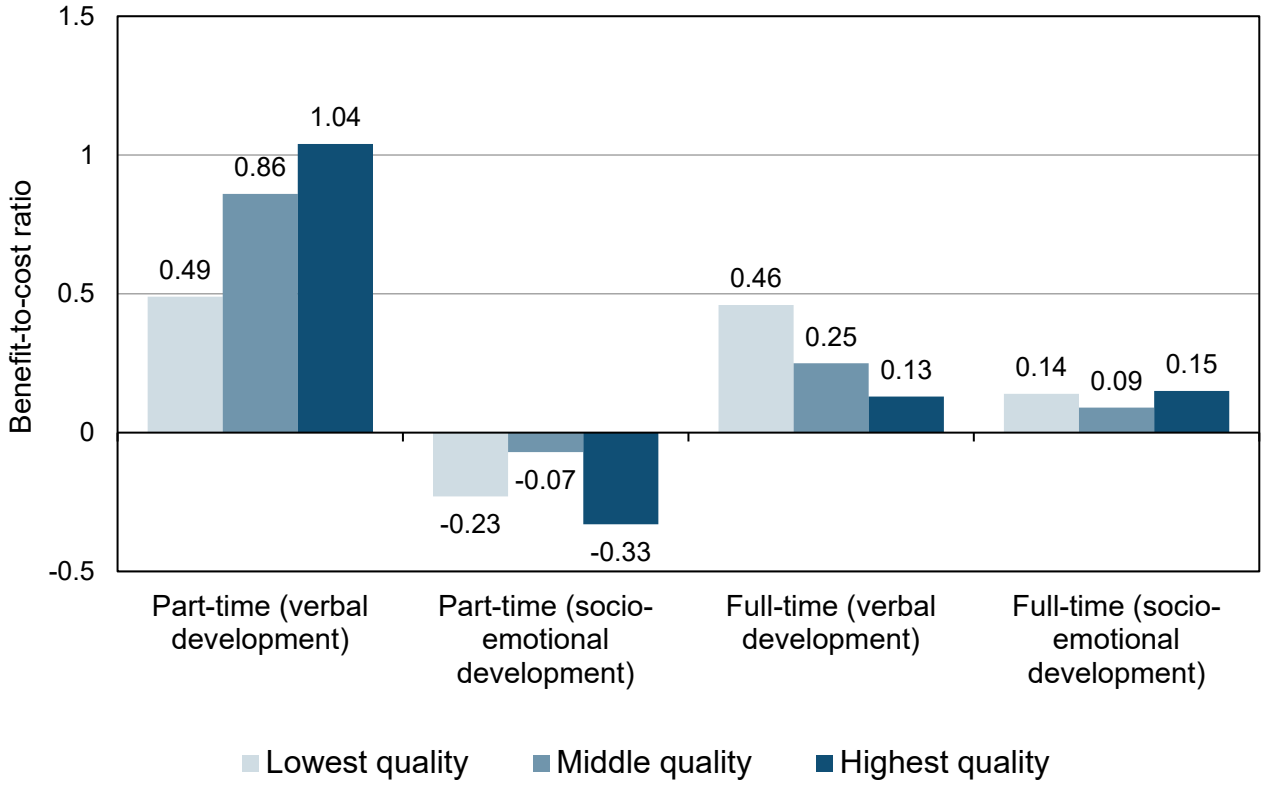


Figure 7: BCRs by setting quality for early education age three



Figures 6 and 7 show that for group-based providers:

- The largest BCRs are for verbal development for part-time early education at both ages across all three quality levels.
- BCRs are more moderate but positive for verbal development and socio-emotional development for full-time early education at both age levels across all three quality levels.
- There are negative BCRs for socio-emotional development for part-time early education at age two in middle quality settings and for part-time early education at age three for all three quality levels.

The figures show few patterns in the BCR across quality levels:

- The BCRs for verbal development increase with setting quality in part-time early education at age three.
- The BCRs for verbal development decline with setting quality for part-time early education at age two and for full-time early education at age three.

Overall, there is no consistent pattern in the BCRs across setting quality level, reflecting the absence of strong associations between cost or impacts and quality. This could be due to insufficient variation in quality (particularly in the proportion of settings with lower quality) to identify any clear patterns.[26]

5.5 BCRs by child disadvantage group

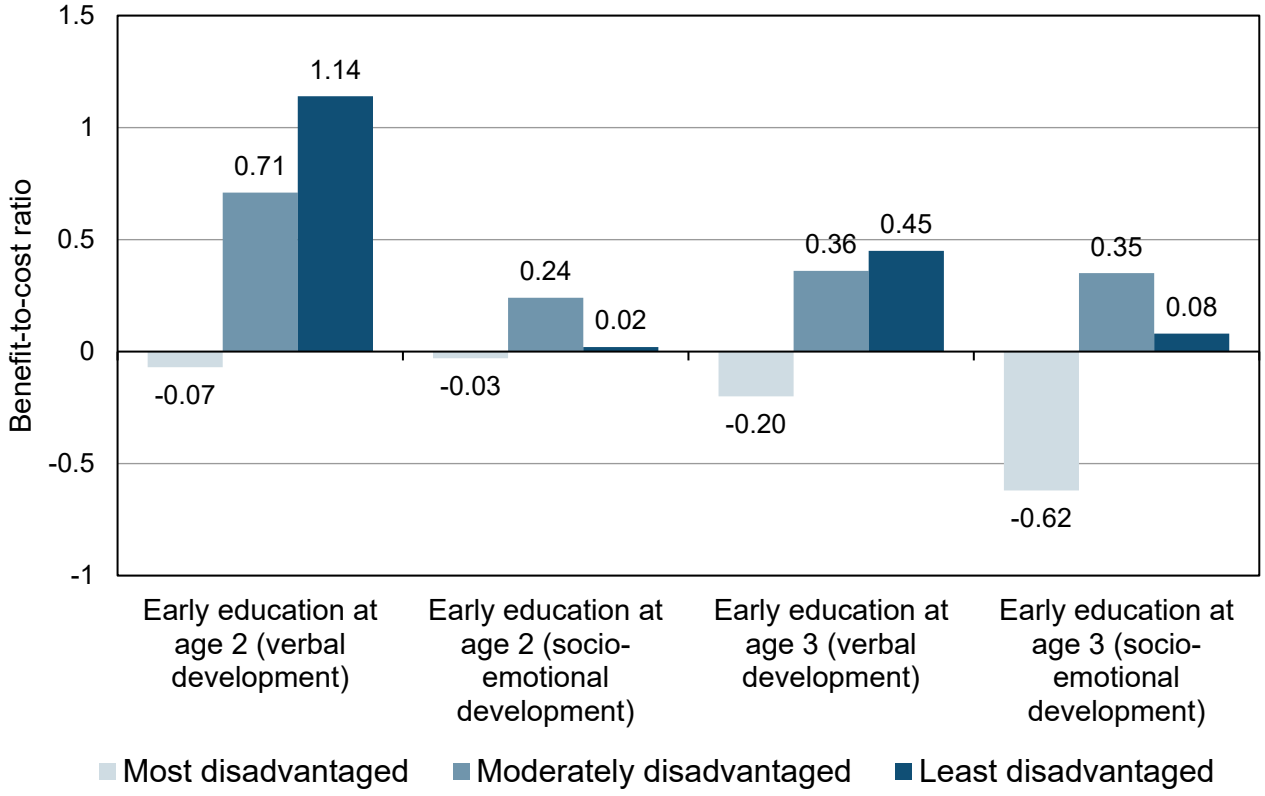
Figure 8 presents the estimated BCRs by child disadvantage level. The figure shows:

- The BCRs are positive for the moderately and least disadvantaged children, but are negative for the most disadvantaged children.
- The BCRs capturing verbal development are larger for the least disadvantaged children than those in the middle group, while the picture is reversed for BCRs capturing socio-emotional development.

Although annual costs are highest for the moderately and least disadvantaged groups, this is outweighed by the higher impacts for the moderately and least disadvantaged children.

[26] The associations between quality and impact are considered in more detail in the Annex.

Figure 8: BCRs by child level of disadvantage



In general, comparison of BCRs across children with different levels of disadvantage should be treated with caution because the existing literature did not identify whether the value of impacts differed across children with different levels of disadvantage. If the value of impacts were higher for children in more disadvantaged groups (for example, the same size impact on verbal development could have a larger impact on lifetime earnings for more disadvantaged children), the BCRs presented here would be understated for more disadvantaged children.[27]

However, this caveat does not affect the conclusions reached here because the BCRs for the most disadvantaged group are not only smaller but also negative. Even if the valuation of the impact were higher for more disadvantaged children, the BCRs for the moderately and least disadvantaged groups would be positive and higher than the negative BCRs for the most disadvantaged group. In other words, the conclusions by disadvantage group are driven only by the negative impact estimates for the most disadvantaged children and are unaffected by any limitations in the valuations of impacts.

[27] In addition, the objective of narrowing attainment gaps between the most and least disadvantaged children could mean that the same size of impact would have higher *social* value for more disadvantaged children.

6. Summary

This report has considered the value for money for several different early education options by estimating and comparing benefit-to-cost ratios (BCRs) estimated for attending early years provision at ages two and three on two outcomes measured at ages three and four. The evidence suggests that the greater returns operate through verbal development rather than socio-emotional development and are higher for early education with childminders than other types of providers.

Later work in this component of SEED will consider the value for money using estimated impacts of early education at ages two and three on longer-term child outcomes at age seven.

References

Blainey, S. and Paull, G., (2017), *Study of Early Education and Development (SEED): The Cost and Funding of Early Education*, Department for Education Research Report DFE-RR552, January https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/586235/SEED_-_The_cost_and_funding_of_early_education_-_RR552.pdf

Brewer, M., Cattan, S., Crawford, C., and Rabe, B., (2016), "Free childcare and parents' labour supply: is more better?", Institute for Fiscal Studies Working Paper W16/22, November https://www.ifs.org.uk/uploads/publications/wps/WP201622.pdf

Melhuish, E. and Gardiner, J., (2017), *Study of Early Education and Development (SEED): Study of Quality of Early Years Provision in England (Revised)*, Department for Education Research Report DFE-RR706, December 2017 (Revised May 2018) https://www.gov.uk/government/publications/early-years-provision-quality

Melhuish, E. and Gardiner, J., (2018), *Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to Age Four Years*, Department for Education Research Report DFE-RR843, September https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/738725/SEED_Impact_Age_4_Report_September_2018.pdf

Melhuish, E. Gardiner, J. and Morris, S., (2017), *Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to Age Three*, Department for Education Research Report DFE-RR706, July https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627098/SEED_ECEC_impact_at_age_3.pdf

Paull, G. and La Valle, I. (2018), *Evaluation of the First Year of the National Rollout of 30 Hours Free Childcare*, Department for Education Research Report DFE-RR832, September https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740168/Evaluation_of_national_rollout_of_30_hours_free-childcare.pdf

Paull, G. and Xu, X., (2017), *Study of Early Education and Development (SEED): The Potential Value for Money of Early Education*, Department for Education Research Report DFE-RR665, July https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/627095/Frontier_SEED_VfM_Report.pdf

Paull, G. and Xu, X., (2019), *Early Years Providers Cost Study 2018*, Department for Education Research Report DFE-RR894, February https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/782471/Frontier_-_Childcare_Cost_Study.pdf

Technical Annex: Impact Analysis

This Technical Annex was authored by Julian Gardiner and Edward Melhuish of the University of Oxford.

A.1 Introduction

This annex give details of analyses of associations between aspects of children's early childhood education and care (ECEC) use and their verbal ability (British Ability Scales (BAS) naming vocabulary) and behavioural difficulties (Strengths and Difficulties Questionnaire (SDQ) total difficulties scores). These analyses were carried out specifically for use in the value for money strand of the SEED project.

The following caveats should be noted:

- These analyses include just two child outcomes, and the methods are tailored specifically for use in the value for money study. Analyses of a wider range of child outcomes and the potential impact of ECEC use can be found in the SEED impact reports.[28] These include analyses of the subscales that make up the SDQ total difficulties score analysed here.

- The no ECEC use / low ECEC use comparison groups used in these analyses are relatively small. The characteristics of these groups are considered further in this annex; see the section "Subgroup characteristics", p 62.

- The value for money analyses depend on the assumption that the relationships between ECEC use and child outcomes are causal. Whilst this assumption is plausible, given the large number of covariates that act as control variables, it requires some justification and qualification. For example, there could be confounding factors that have not been controlled for because they were not measured.[29]

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[28] See "Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to Age Three", July 2017.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627098/SEED_ECEC_impact_at_age_3.pdf
and:
"Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to age four years", September 2018.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/738725/SEED_Impact_Age_4_Report_September_2018.pdf

[29] This question is discussed in Chapter 2 of "Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to age four years: Technical Annex to the Main Report", September 2018.

A.2 Method

Overview

Child outcomes measured at age 3 were analysed in terms of aspects of formal ECEC usage aged 2 to 3. Outcomes at age 4 were analysed in terms of aspects of formal ECEC usage aged 3 to 4. Two child outcomes were analysed:

1. Strengths and Difficulties Questionnaire (SDQ) Total Difficulties score
2. British Ability Scales (BAS) Naming Vocabulary (verbal ability score)

The SDQ Total Difficulties score was derived from parental report. The BAS Naming Vocabulary score was derived from an assessment by a researcher, performed according to the procedures in the BAS manual.

Four analyses were undertaken (described in more detail on page 58 under the heading 'description of the four analyses performed'):

1. Analysis in terms formal ECEC use: full time / part time / no or low use.
2. Analysis in terms of the type of formal ECEC used.
3. Analysis in terms of the quality of formal ECEC used.
4. Analysis in terms of formal ECEC use, with effects analysed separately by disadvantage group.

Covariates

All models controlled for informal ECEC usage, i.e. the amount of ECEC with friends, relatives, neighbours and nannies (aged 2 to 3 for analyses of the 3 year old outcomes, aged 3 to 4 for analyses of the 4 year old outcomes).

All models also controlled for 14 demographic covariates:

1. Child's sex
2. Child's ethnic group
3. Child's birth weight

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/738726/SEED_Impact_Age_4_Report_September_2018_Technical-Report.pdf

4. Maternal age at birth of child
5. Child's birth order
6. SEED disadvantage group
7. Mother's highest qualification
8. Family socio-economic status
9. Number of siblings living with child
10. Couple / loan parent household
11. Working / non-working household
12. Family income
13. Index of Multiple Deprivation
14. Family's accommodation tenure (renting / owner occupier / living rent free)

For the time-varying demographic covariates, the Wave 1 values (data collected when children were aged around 2) were used for the analysis of the 3 year old outcomes, the Wave 2 values (data collected when children were aged around 3) were used for the analysis of the 4 year old outcomes.

Models controlled for 6 home environment covariates. For the analysis of the age 3 outcomes, the following measures from Wave 1 were used:

1. Home learning environment
2. Household disorder (CHAOS scale)
3. Parent's Kessler psychological distress
4. Parental limit setting (PCCT scale)
5. Parent / child closeness (PIANTA scale)
6. Parent / child conflict (PIANTA scale)

For the analysis of the age 4 outcomes, the following measures from Wave 2 were used:

1. Home learning environment
2. Household disorder (CHAOS scale)
3. Parent's Kessler psychological distress

4. Parental limit setting (PCCT scale)
5. Parent / child relationship: MORS warmth scale
6. Parent / child relationship: MORS invasiveness scale

Choice of comparison group

In order to estimate the effect of formal ECEC use on children's outcomes it is necessary to use a reference group with which children using formal ECEC can be compared. Ideally, this would be a group of children who are not using formal ECEC. For the analysis of the age 3 outcomes, such a "no use" comparison group was available consisting of 387 children who used no formal ECEC between ages 2 and 3. However, only 38 children used no formal ECEC between aged 3 and 4, reflecting that there is very high take-up of the universal Government entitlement for 3-4 year-olds This would be unfeasibly small for a comparison group. Therefore a "low use" comparison group was adopted instead; this consisted of the 165 children who had used not more than a mean of 5 hours per week formal ECEC overall between ages 3 and 4 years.

Table 23: Breakdown of sample by ECEC usage band with mean formal ECEC usage for children aged 2 to 3

ECEC usage band	N	Mean weekly formal ECEC usage aged 2 to 3
No ECEC	387	0.00
Part time	2893	6.95
Full time	1303	25.42
Full time	2195	22.97

Mean weekly formal ECEC usage is calculated over the 38 weeks of the school terms.

Table 24: Breakdown of sample by ECEC usage band with mean formal ECEC usage for children aged 3 to 4

ECEC usage band	N	Mean weekly formal ECEC usage aged 3 to 4
Low ECEC	165	2.21
Part time	1570	11.90
Full time	2195	22.97

Mean weekly formal ECEC usage is calculated over the 38 weeks of the school terms.

A breakdown of the sample by ECEC usage band is given in tables 23 and 24, with mean formal ECEC usage shown for each band. The effectiveness of the models for children aged 3 to 4, which use a low formal ECEC use reference group rather than a no formal ECEC reference group, depends partly on whether the relationships between ECEC usage and the outcome variables are approximately linear. If this is the case, then the contrast between the part-time group (with mean usage of approximately 12 hours per week) and the low ECEC use reference group (with mean usage of approximately 2

hours per week) will be similar to the contrast between children with a mean weekly usage of 10 hours per week and a reference group with no formal ECEC usage, if such a reference group were available. Analysis of the SEED data shows that the ECEC usage / outcome variable relationships are approximately linear,[30] suggesting that the analysis for 3 to 4 year olds is satisfactory.

A note on types of ECEC

The SEED study has employed a three-way categorization of ECEC:

1. Formal group ECEC, in playgroups, nursery classes, nursery schools and local authority nurseries.

2. Formal individual ECEC, with childminders.

3. Informal individual ECEC, with friends, family and nannies.

The analyses here are generally in terms of the amount of formal ECEC used: including both formal group ECEC and formal individual ECEC (childminders).

The analysis of ECEC quality is in terms of formal group ECEC only, as quality data was not collected for childminders.

Further details of the statistical models used

The outcome variables were standardized to have a mean of zero and a standard deviation of one.

Note that in this appendix the SDQ total difficulties scale has higher values associated with higher levels of child difficulties. In the main body of this report, this scale has been reversed so that higher values are associated with lower levels of child difficulties. This was done so that higher values were associated with better child outcomes for both the BAS verbal ability (naming vocabulary) and SDQ total difficulties scales.

Because the data were clustered, the regression models used were mixed-effects multivariate regression models. Random effects were fitted for government region, stratum within government region and primary sampling unit (PSU) within stratum.

[30] See "Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to age four years", September 2018. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/738725/SEED_Impact_Age_4_Report_September_2018.pdf

Models were fitted to multiply imputed data. The imputation model included all outcome variables and covariates. Ten imputed data sets were generated. Models were fitted to all imputed data sets and combined using Rubin's rules.[31]

Effects (Beta) give the change in the outcome variable corresponding to the specified covariate contrast (e.g., some formal ECEC used vs. no formal ECEC used), controlling for the effects of all other covariates. Statistical significance is reported using p values.

Description of the four analyses performed

Analysis in terms full time / part time / no or low formal ECEC use

Full time usage was defined as > 15 hours per week mean annual usage of formal ECEC over the 38 weeks of the school year.

Part time usage was defined as ≤ 15 hours per week mean annual usage of formal ECEC over the 38 weeks of the school year.

For the age 3 outcomes, the models contrasted the effect of full-time and part-time formal ECEC use with no formal ECEC use.

For the 4 year old outcomes, the models contrasted the effect of full-time and part-time formal ECEC usage with the effect of low formal ECEC usage (≤ 5 hours per week mean annual usage over the 38 weeks of the school year).

Analysis in terms of the type of formal ECEC used

Formal ECEC usage was classified into three types:

1. Maintained settings
2. Private / Voluntary / Independent (PVI) settings
3. Childminders

The type and amount of childminder ECEC usage was derived from parental report. The amount of Maintained / PVI ECEC usage was derived from the parental report whilst the type was derived from a combination of parental report and administrative data on ECEC settings.

[31] Further discussion of the use of multiple imputation for analyses in the SEED study can be found in Chapter 4 of "Study of Early Education and Development (SEED): Impact Study on Early Education Use and Child Outcomes up to Age Three: Technical Annex to the Main Report", July 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627124/SEED_Impact_at_age_3_Technical_Report.pdf

The ECEC settings were classified as follows:

Private → PVI

Voluntary → PVI

Local Authority nurseries → Maintained

Nursery class → Maintained

Nursery school → Maintained

Children's centre → Maintained

Note that due to sample size considerations it was not possible to break down formal group ECEC usage into a finer classification than the two-way PVI / Maintained split which was used.

The 3 year old outcomes were analysed in terms of type of ECEC used aged 2 to 3. This type data was derived from data at Wave 1 and Wave 2 (i.e. as reported at the beginning and end of the period of interest).

The 4 year old outcomes were analysed in terms of type of ECEC used aged 3 to 4. This type data was derived from data at Wave 2 and Wave 3 (i.e. as reported at the beginning and end of the period of interest).

In order to determine whether a child had used a given type of ECEC part-time or full-time, the time for which ECEC was used was derived from parental report in two categories:

1. Hours per week spent with childminders ("formal individual ECEC")
2. Hours per week spent in all other types of formal ECEC ("formal group ECEC")

The latter quantity ("formal group ECEC use") was assigned to either Maintained or PVI usage according to the setting type data. Where the setting type data indicated that a child had used both types of ECEC, the formal group ECEC usage was divided equally between the two types.

The principal model covariates were 6 dummy variables indicating whether a given type of ECEC had been used and whether it had been used part-time or full-time:

1. Part-time Childminder
2. Part-time PVI
3. Part-time Maintained

4. Full-time Childminder
5. Full-time PVI
6. Full-time Maintained

Note that children's part-time / full-time status is considered separately for each type of ECEC and that it is possible for a child to be included in more than one of the above six categories. For example, a child might have a total ECEC usage in the "full time" range, but made up of PVI and Childminder components. For the purpose of the "type" models this child would be included in both the "Part-time PVI" and "Part-time Childminder" categories rather than in a "full-time" category.

For the 3 year old outcomes, the type and amount of formal ECEC used was compared with a no formal ECEC use comparison group. Children were excluded from the model if they had some formal ECEC usage aged 2 to 3 but no type could be assigned: N = 197.

For the 4 year old outcomes, the type and amount of formal ECEC used was compared with a low formal ECEC use comparison group (i.e. ≤ 5 hours per week formal ECEC mean annual usage over the 38 weeks of the school terms). Children were excluded from the model if they had > 5 hours per week formal ECEC usage aged 3 to 4 but no type could be assigned: N = 333.

Analysis in terms of the quality of formal ECEC used

The SEED quality strand collected data on 1000 settings used by 2 and 3 year olds in the SEED study. However, data was not available for all the settings attended by children in the study; therefore the quality analyses have a smaller sample size than the other analyses.

Age 3 outcomes were analysed in terms of quality of ECEC settings attended at age 2 (Wave 1). Settings' quality was measured using:

1. SSTEW
2. ITERS-R

Age 4 outcomes were analysed in terms of quality of ECEC settings attended at age 3 (Wave 2). Settings' quality was measured using:

1. SSTEW
2. ECERS-R
3. ECERS-E

The settings quality data from each wave was combined to create a mean quality setting value. Settings were then classified into three quality bands:

1. Low quality: scores < 4.5
2. Medium quality: scores ≥ 4.5 and < 5.5
3. High quality: scores ≥ 5.5

The principal model covariate was a 6-level factor combining the quality of the ECEC received and whether formal ECEC has been used part-time or full-time:

1. Part-time Low quality
2. Part-time Medium quality
3. Part-time High quality
4. Full-time Low quality
5. Full-time Medium quality
6. Full-time High quality

For the 3 year old outcomes, the quality and amount of formal ECEC used was compared with a no formal ECEC use comparison group. Children were included in the model if:

- They had no formal ECEC usage aged 2 to 3 (N = 387), or
- They had quality data available from Wave 1 (N = 871).

Total sample size = 1258.

For the 4 year old outcomes, the quality and amount of formal ECEC used was compared with a low formal ECEC use comparison group (i.e. ≤ 5 hours per week formal ECEC mean annual usage over the 38 weeks of the school terms). Children were included in the model if:

- They had a mean of ≤ 5 hours/week formal ECEC usage aged 3 to 4 (N = 165), or
- They had quality data available from Wave 2 (N = 1095).

Total sample size = 1260.

Analysis in terms of formal ECEC use, with effects analysed separately by disadvantage group

For the age 3 outcomes, the models contrasted the effect of any formal ECEC use with no formal ECEC use, with separate effects fitted for each SEED disadvantage group.

For the 4 year old outcomes, the models contrasted the effect of substantial formal ECEC usage (> 5 hours per week mean annual usage over the 38 weeks of the school terms) with the effect of minimal formal ECEC usage (≤ 5 hours per week mean annual usage over the 38 weeks of the school terms), with separate effects fitted for each SEED disadvantage group.

Note that in all cases the effects of ECEC usage are calculated within each disadvantage group: e.g., the outcomes of children in the most disadvantaged group using formal ECEC are contrasted with those of children in the most disadvantaged group using low or no formal ECEC.

Analysis in terms of formal ECEC use, with effects analysed separately by disadvantage group: models with additional covariates

A second set of models with separate effects of ECEC use by disadvantage group were fitted including four additional covariates:

1. Amount of formal group ECEC used
2. Whether PVI ECEC was used
3. Whether Maintained ECEC was used
4. Whether Childminder ECEC was used

A.3 Subgroup characteristics

Introduction

Characteristics of the sample were analysed according to level of formal ECEC use: no use / part time / full time for 2 year olds, low use / part time / full time for 3 year olds.

Method

The following eight variables were compared between groups:

1. Home Learning Environment (HLE) score
2. Ethnic Group
3. SEED disadvantage group
4. Mother's highest qualification
5. Family socio-economic status (SES)
6. Couple / lone parent household

7. Working / non-working household

8. Family income

For the continuous variable Home Learning Environment score, the group means are compared in **Error! Reference source not found.** (children aged 2) and **Error! Reference source not found.** (children age 3). The means in the part time / full time groups were compared with those in the no use / low use group using a non-parametric Wilcoxon rank sum test.[32]

For the remaining categorical variables, breakdowns are compared between groups; see **Error! Reference source not found.** (children aged 2) and **Error! Reference source not found.** (children aged 3). For each variable, the proportions in each category are compared between the part time / full time groups and the no use / low use group using a chi-square test.

Results

There were no significant differences in Home Learning Environment between groups (Tables 25 and 26).

There were differences between groups on a number of demographic measures (Tables 27 and 28). These show that higher bands of ECEC use are associated with families coming from higher socio-economic status groups, where the family is more likely to be working and where the mother is more likely to have a relatively high level of educational attainment.

There are also some differences in ECEC use by ethnic group, with lower take up in particular for children from ethnically Asian families (see Tables 27 and 28). This is consistent with research which has shown that BME families may be reluctant to send their children to childcare as this could erode their cultural norms and traditions (Albakri 2018).

Note that these associations between demographic factors and ECEC use group do not invalidate the analyses since all these demographic variables are controlled for in the models. There remains, however, the possibility that there could be further, unobserved factors associated with both ECEC group membership and the outcome variables. The existence of such confounding variables can never be entirely ruled out in observational studies.

An example of a possible confounder is children having special educational needs / disabilities (SEN/D). Children's SEN/D status was not recorded in the SEED study and it

[32] This is similar to a t-test, but does not require the assumption that the variables are normally distributed.

is known that SEN/D children are less likely than other children to make use of out of home ECEC (Albakri 2018; Griggs 2017). The observed effects of formal ECEC usage are therefore subject to some degree of confounding with children's SEN/D status.

Table 25: Mean Home Learning Environment score by band of formal ECEC use; age 2

Variable	No use N = 387	Part Time (15 hours or less per week) N = 2893	Full Time (over 15 hours per week) N = 1303
Home learning environment	23.49	23.83	24.01

Sample size = 4583

Where the mean in the Part Time / Full Time group was significantly different from the mean in the No use group this is marked by stars: * = p < 0.05, ** = p < 0.01, *** = p < 0.001. (Non-parametric Wilcoxon rank-sum test). No differences were statistically significant.

Table 26: Mean Home Learning Environment score by band of formal ECEC use; age 3

Variable	Low use (5 hours or less per week) N = 165	Part Time (over 5 hours up to 15 hours per week) N = 1570	Full Time (over 15 hours per week) N = 2195
Home learning environment	21.41	21.63	21.64

Sample size = 3930

Where the mean in the Part Time / Full Time group was significantly different from the mean in the Low use group this is marked by stars: * = p < 0.05, ** = p < 0.01, *** = p < 0.001. (Non-parametric Wilcoxon rank-sum test). No differences were statistically significant.

Table 27: Percentages for demographic variables by band of formal ECEC use; age 2

Variable	Level	No use	Part Time (15 hours or less per week)	Full Time (over 15 hours per week)
Ethnic Group	White	71.3	84.2 ***	84.8 ***
	Asian	16.5	7.1 ***	2.7 ***
	Black	6.7	3.2 ***	5.7
	Mixed / Other	5.4	5.6	6.8
SEED disadvantage group	20% most disadvantaged	30.2	29.4	18.6 ***
	20%-40% most disadvantaged	39.3	35.1	35.1
	60% least disadvantaged	30.5	35.5	46.4 ***
Mother's highest qualification	No formal qualifications	18.3	9.3 ***	3.2 ***
	GCSE Grade D-G	7.4	7.0	3.9 **
	GCSE Grade A*-C	30.6	28.2	19.4 ***
	A-Level or equivalent	24.0	27.6	26.6
	First degree	13.4	18.9 *	27.9 ***
	Higher degree	6.3	9.0	18.9 ***
Family SES	Professional / managerial	6.2	12.5 ***	24.6 ***
	Intermediate / lower managerial	33.3	40.7 **	47.8 ***
	Small employer / self-employed	9.8	9.0	5.0 ***
	Lower supervisory	9.8	7.8	4.5 ***
	Routine / semi-routine	32.8	25.4 **	15.3 ***
	Not working	8.0	4.6 **	2.8 ***
Couple / lone parent household	Couple	73.1	73.8	72.3
	Lone parent	26.9	26.2	27.7
Working / non-working household	Someone working	72.1	74.1	83.3 ***
	No one working	27.9	25.9	16.7 ***
Family income	< £10,000 p.a.	19.9	16.6	11.8 ***
	£10,000 to < £20,000 p.a.	32.3	25.9 *	17.8 ***
	£20,000 to < £40,000 p.a.	33.7	33.8	28.5
	£40,000 or more p.a.	14.1	23.8 ***	41.8 ***

Sample size = 4583

Where the proportion in a given category in the Part Time / Full Time group was significantly different from the proportion in that category in the No use group this is marked by stars: * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$. (Chi-square test).

Table 28: Percentages for demographic variables by band of formal ECEC use; age 3

Variable	Level	Low use (5 hours or less per week)	Part Time (over 5 hours up to 15 hours per week)	Full Time (over 15 hours per week)
Ethnic Group	White	75.8	82.8 *	85.5 **
	Asian	12.1	8.3	4.2 ***
	Black	4.2	3.9	4.0
	Mixed / Other	7.9	5.0	6.3
SEED disadvantage group	20% most disadvantaged	35.8	25.0 **	23.1 ***
	20%-40% most disadvantaged	35.2	38.0	33.8
	60% least disadvantaged	29.1	37.0	43.1 ***
Mother's highest qualification	No formal qualifications	13.5	9.7	4.9 ***
	GCSE Grade D-G	9.6	7.1	5.2 *
	GCSE Grade A*-C	32.7	27.2	22.9 **
	A-Level or equivalent	26.9	28.2	26.9
	First degree	10.9	18.1 *	25.3 ***
	Higher degree	6.4	9.7	14.8 **
Family SES	Professional / managerial	6.1	12.9 *	19.7 ***
	Intermediate / lower managerial	35.8	40.4	46.1 *
	Small employer / self-employed	8.5	9.0	6.8
	Lower supervisory	10.9	7.9	6.0 *
	Routine / semi-routine	33.3	25.8 *	17.9 ***
	Not working	5.5	4.1	3.6
Couple / lone parent household	Couple	67.9	77.8 **	75.0
	Lone parent	32.1	22.2 **	25.0
Working / non-working household	Someone working	71.5	80.0 *	82.4 ***
	No one working	28.5	20.0 *	17.6 ***
Family income	< £10,000 p.a.	17.8	16.0	12.0 *
	£10,000 to < £20,000 p.a.	32.9	23.0 **	19.4 ***
	£20,000 to < £40,000 p.a.	33.6	36.2	30.5
	£40,000 or more p.a.	15.8	24.9 *	38.2 ***

Sample size = 3930

Where the proportion in a given category in the Part Time / Full Time group was significantly different from the proportion in that category in the Low use group this is marked by stars: * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$. (Chi-square test).

A.4 Results

The results of the models in terms of full time / part time formal ECEC use are given in Table 29 (age 3 outcomes) and Table 30 (age 4 outcomes).

The results of models in terms of type of formal ECEC used are given in Table 31 (age 3 outcomes) and Table 32 (age 4 outcomes).

The results of models in terms of the quality of formal ECEC used are given in Table 33 (age 3 outcomes) and Table 34 (age 4 outcomes).

The results of models in terms of formal ECEC usage separately by disadvantage group are given in Table 35 (age 3 outcomes) and Table 36 (age 4 outcomes). The models with the inclusion of four additional covariates are given in Table 37 (age 3 outcomes) and Table 38 (age 4 outcomes). Including the additional covariates made relatively little difference to the model results.

Table 29: Results for age 3 outcomes in terms of full time formal ECEC use aged 2 to 3 / part time formal ECEC use aged 2 to 3 / no formal ECEC use aged 2 to 3

Outcome	Group	Background statistics		Absolute Impact		Relative impact	
		Mean	SD	Beta	P	Beta	p
SDQ Total difficulties	No ECEC	0.17	1.02				
				Part time over none			
	Part time	0.05	1.00	-0.006	0.891	Full time over part time	
				Full time over none			
	Full time	-0.16	0.98	-0.078	0.133	-0.071	0.017 *
BAS Naming Vocabulary	No ECEC	-0.36	1.02				
				Part time over none			
	Part time	-0.03	1.01	+0.146	0.003 **	Full time over part time	
				Full time over none			
	Full time	0.16	0.93	+0.202	<0.001 ***	+0.055	0.075

Sample size = 4583
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 30: Results for age 4 outcomes in terms of full time formal ECEC use age 3 to 4 / part time formal ECEC age 2 to 3 / ≤ 5 hours per week formal ECEC use age 3 to 4

Outcome	Group	Background statistics		Absolute Impact		Relative impact	
		Mean	SD	Beta	P	Beta	p
SDQ Total difficulties	Low ECEC	0.12	1.07				
				Part time over low			
	Part time	0.05	1.00	+0.032	0.635	Full time over part time	
				Full time over low			
	Full time	-0.04	0.99	+0.004	0.952	-0.028	0.317
BAS Naming Vocabulary	Low ECEC	-0.18	1.04				
				Part time over low			
	Part time	-0.09	1.03	+0.018	0.812	Full time over part time	
				Full time over low			
	Full time	0.08	0.97	+0.066	0.370	+0.048	0.122

Sample size = 3930
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 31: Results for age 3 outcomes in terms of type of formal ECEC used and full-time / part-time use age 2 to 3 vs. no formal ECEC use age 2 to 3

Outcome	Group	Background statistics		Impact	
		Mean	SD	Beta	p
SDQ Total difficulties	No ECEC	0.17	1.02	Reference level	
	PT Childminder	-0.21	0.98	-0.071	0.196
	PT PVI	0.02	1.01	+0.041	0.257
	PT Maintained	0.14	1.03	+0.017	0.659
	FT Childminder	-0.22	0.89	-0.051	0.432
	FT PVI	-0.23	0.94	-0.103	0.026 *
	FT Maintained	0.06	1.13	+0.057	0.533
BAS Naming Vocabulary	No ECEC	-0.36	1.02	Reference level	
	PT Childminder	0.29	0.90	+0.138	0.016 *
	PT PVI	0.05	1.01	+0.103	0.007 **
	PT Maintained	-0.14	1.01	+0.067	0.103
	FT Childminder	0.38	0.89	+0.266	<0.001 ***
	FT PVI	0.15	0.92	+0.117	0.016 *
	FT Maintained	0.05	0.94	+0.223	0.018 *

Sample size = 4386
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 32: Results for age 4 outcomes in terms of type of formal ECEC used and full-time / part-time use age 3 to 4 vs. ≤ 5 hours per week formal ECEC use age 3 to 4

Outcome	Group	Background statistics		Impact	
		Mean	SD	Beta	p
SDQ Total difficulties	Low ECEC	0.12	1.07	Reference level	
	PT Childminder	-0.18	0.86	-0.058	0.235
	PT PVI	-0.04	0.98	+0.034	0.496
	PT Maintained	0.16	1.06	+0.141	0.009 **
	FT Childminder	-0.19	0.86	-0.038	0.627
	FT PVI	-0.06	0.98	+0.031	0.550
	FT Maintained	0.08	1.01	+0.025	0.692
BAS Naming Vocabulary	Low ECEC	-0.18	1.04	Reference level	
	PT Childminder	0.24	1.00	+0.110	0.038 *
	PT PVI	0.08	0.99	+0.145	0.009 **
	PT Maintained	-0.07	0.99	+0.140	0.019 *
	FT Childminder	0.24	0.85	+0.115	0.184
	FT PVI	0.11	0.96	+0.145	0.012 *
	FT Maintained	-0.10	0.98	+0.169	0.017 *

Sample size = 3597
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 33: Results for age 3 outcomes in terms of quality of formal ECEC used and full-time / part-time use age 2 to 3 vs. no formal ECEC use age 2 to 3

Outcome	Group	Background statistics		Impact	
		Mean	SD	Beta	p
SDQ Total difficulties	No ECEC	0.17	1.02	Reference level	
	PT Low quality	0.14	0.99	-0.039	0.651
	PT Medium quality	0.22	1.14	+0.087	0.286
	PT High quality	-0.03	0.83	-0.131	0.138
	FT Low quality	-0.12	1.00	-0.133	0.166
	FT Medium quality	-0.20	1.03	-0.124	0.164
	FT High quality	-0.18	1.00	-0.143	0.136
BAS Naming Vocabulary	No ECEC	-0.36	1.02	Reference level	
	PT Low quality	0.12	0.98	+0.264	0.003 **
	PT Medium quality	0.15	0.88	+0.260	0.002 **
	PT High quality	0.04	1.07	+0.210	0.021 *
	FT Low quality	0.11	0.94	+0.131	0.190
	FT Medium quality	0.22	0.91	+0.248	0.007 **
	FT High quality	0.16	0.90	+0.179	0.070

Sample size = 1258
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 34: Results for age 4 outcomes in terms of quality of formal ECEC used and full-time / part-time use age 3 to 4 vs. ≤ 5 hours per week formal ECEC use age 3 to 4

Outcome	Group	Background statistics		Impact	
		Mean	SD	Beta	p
SDQ Total difficulties	Low ECEC	0.12	1.07	Reference level	
	PT Low quality	0.18	0.97	+0.043	0.652
	PT Medium quality	-0.10	0.91	+0.013	0.893
	PT High quality	0.16	0.97	+0.063	0.545
	FT Low quality	-0.05	0.93	-0.049	0.558
	FT Medium quality	-0.11	0.99	-0.031	0.715
	FT High quality	-0.11	0.94	-0.057	0.525
BAS Naming Vocabulary	Low ECEC	-0.18	1.04	Reference level	
	PT Low quality	-0.07	1.06	+0.073	0.495
	PT Medium quality	0.05	0.96	+0.121	0.274
	PT High quality	0.08	0.91	+0.160	0.174
	FT Low quality	0.10	0.95	+0.135	0.156
	FT Medium quality	0.08	0.93	+0.070	0.454
	FT High quality	0.08	0.98	+0.040	0.698

Sample size = 1260
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 35: Results for age 3 outcomes in terms of any formal ECEC used age 2 to 3 separately for each disadvantage group vs. no formal ECEC use age 2 to 3

Outcome	Group	Background statistics		Absolute Impact		Relative impact	
		Mean	SD	Beta	P	Beta	p
SDQ Total difficulties	No ECEC	0.17	1.02				
				Most disadvantaged over no ECEC		Intermediate over most	
	Most disadvantaged	0.31	1.05	+0.009	0.911	-0.083	0.458
				Intermediate over no ECEC		Least over most	
	Intermediate	0.00	1.00	-0.073	0.320	-0.017	0.883
				Least disadvantaged over no ECEC		Least over intermediate	
	Least disadvantaged	-0.25	0.89	-0.008	0.924	+0.065	0.551
BAS Naming Vocabulary	No ECEC	-0.36	1.02				
				Most disadvantaged over no ECEC		Intermediate over most	
	Most disadvantaged	-0.27	0.95	-0.014	0.873	+0.190	0.100
				Intermediate over no ECEC		Least over most	
	Intermediate	-0.05	1.01	+0.176	0.022 *	+0.320	0.009 **
				Least disadvantaged over no ECEC		Least over intermediate	
	Least disadvantaged	0.30	0.94	+0.306	<0.001 ***	+0.130	0.254

Sample size = 4583
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 36: Results for age 4 outcomes in terms of any formal ECEC used age 3 to 4 separately for each disadvantage group vs. ≤ 5 hours per week formal ECEC use age 3 to 4

Outcome	Group	Background statistics		Absolute Impact		Relative impact	
		Mean	SD	Beta	P	Beta	p
SDQ Total difficulties	Low ECEC	0.12	1.07				
				Most disadvantaged over low ECEC		Intermediate over most	
	Most disadvantaged	0.37	1.07	+0.182	0.095	-0.295	0.057
				Intermediate over low ECEC		Least over most	
	Intermediate	0.01	0.99	-0.113	0.305	-0.208	0.198
				Least disadvantaged over low ECEC		Least over intermediate	
	Least	-0.24	0.88	-0.026	0.830	+0.087	0.593
BAS Naming Vocabulary	Low ECEC	-0.18	1.04				
				Most disadvantaged over low ECEC		Intermediate over most	
	Most disadvantaged	-0.30	0.97	-0.047	0.701	+0.140	0.415
				Intermediate over low ECEC		Least over most	
	Intermediate	-0.09	0.98	+0.093	0.440	+0.172	0.336
				Least disadvantaged over low ECEC		Least over intermediate	
	Least	0.26	0.96	+0.125	0.338	+0.032	0.855

Sample size = 3930
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 37: Results for age 3 outcomes in terms of any formal ECEC used age 2 to 3 separately for each disadvantage group vs. no formal ECEC use age 2 to 3: Models with additional covariates

Outcome	Group	Background statistics		Absolute impact		Relative impact	
		Mean	SD	Beta	p	Beta	p
SDQ Total difficulties	No ECEC	0.17	1.02				
				Most disadvantaged over low ECEC		Intermediate over most	
	Most disadvantaged	0.30	1.04	-0.098	0.320	-0.074	0.504
				Intermediate over low ECEC		Least over most	
	Intermediate	-0.01	1.00	-0.172	0.055	-0.009	0.941
				Least disadvantaged over low ECEC		Least over intermediate	
	Least disadvantaged	-0.25	0.89	-0.107	0.273	+0.066	0.549
BAS Naming Vocabulary	No ECEC	-0.36	1.02				
				Most disadvantaged over low ECEC		Intermediate over most	
	Most disadvantaged	-0.25	0.95	-0.026	0.800	+0.178	0.127
				Intermediate over low ECEC		Least over most	
	Intermediate	-0.04	1.00	+0.152	0.107	+0.298	0.015 *
				Least disadvantaged over low ECEC		Least over intermediate	
	Least disadvantaged	0.30	0.94	+0.272	0.008 **	+0.120	0.293

Sample size = 4386
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

Table 38: Results for age 4 outcomes in terms of any formal ECEC used age 3 to 4 separately for each disadvantage group vs. ≤ 5 hours per week formal ECEC use age 3 to 4: Models with additional covariates

Outcome	Group	Background statistics		Absolute impact		Relative impact	
		Mean	SD	Beta	p	Beta	p
SDQ Total difficulties	No ECEC	0.12	1.07				
				Most disadvantaged over low ECEC		Intermediate over most	
	Most disadvantaged	0.37	1.08	+0.177	0.111	-0.287	0.064
				Intermediate over low ECEC		Least over most	
	Intermediate	0.02	0.99	-0.109	0.328	-0.193	0.233
				Least disadvantaged over low ECEC		Least over intermediate	
	Least disadvantaged	-0.26	0.86	-0.015	0.899	+0.094	0.564
BAS Naming Vocabulary	No ECEC	-0.18	1.04				
				Most disadvantaged over low ECEC		Intermediate over most	
	Most disadvantaged	-0.27	0.96	-0.147	0.236	+0.154	0.369
				Intermediate over low ECEC		Least over most	
	Intermediate	-0.05	0.97	+0.007	0.954	+0.189	0.290
				Least disadvantaged over low ECEC		Least over intermediate	
	Least disadvantaged	0.29	0.94	+0.042	0.750	+0.035	0.842

Sample size = 3597
Statistical significance is marked * = p < 0.05, ** = p < 0.01, *** = p < 0.001.

A.5 References for Technical Annex

Albakri, M., Basi, T., Davies, M., Forsyth, E., Hopwood, V., Patel, B., Skipp, A., Tanner, E. (2018) *Take-up of free early education entitlements,* NatCen Social Research and Ask Research. https://www.gov.uk/government/publications/take-up-of-free-early-education-entitlements

Griggs, J. and Bussard, L. (2017) *Study of Early Education and Development (SEED): Meeting the needs of children with special educational needs and disabilities in the early years,* NatCen Social Research. https://www.gov.uk/government/publications/children-with-send-meeting-their-needs-in-the-early-years

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