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Research Report

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The impact of mothers' learning on their
children's academic performance at Key
Stage 3: evidence from ALSPAC

Ricardo Sabates and Kathryn Duckworth



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Wider Benefits of Learning

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**THE IMPACT OF MOTHERS' LEARNING
ON THEIR CHILDREN'S ACADEMIC
PERFORMANCE AT KEY STAGE 3:
EVIDENCE FROM ALSPAC**

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Executive summary

Parental education is thought to be one of the key factors that promote children's academic development. Empirical studies, using sophisticated analytical techniques and complex research designs, have concluded that parental education does have a causal impact on children's educational achievement. However, the literature tends to focus on the achievement of educational qualifications or years of schooling, and has largely ignored the role of adult education.

In the UK context, where a significant minority of the population continue to leave the educational system without educational qualifications (Cassen and Kingdon, 2007), the hypothesis that higher levels of parental education lead to wider benefits for their children needs to be analysed over the lifecourse as a whole. Do these intergenerational benefits, over and above the achievement of educational qualifications, actually exist? And are the returns to parental adult learning greatest for children of parents with low or high levels of education? Very few studies have investigated these issues, leaving a significant gap in the evidence base for education and family policy.

This study addresses one of these issues: the impact of mothers' learning during adulthood on the subsequent attainment of their children, looking in particular at:

- the relationship between mothers' participation in adult education and children's improvement in Key Stage 3 (KS3) (age 14) English and mathematics test scores;
- whether this relationship varies according to the type of adult learning course taken, the time spent in adult learning by mothers, and the previous educational background of mothers.

Key findings

Taking into account the influence of background factors, in particular mothers' prior education, the results show no association between mothers' adult learning and their children's KS3 English and mathematics scores, i.e. mothers' adult learning showed no added value for their children's achievements between Key Stage 2 (KS2) and KS3.

The results held both for the sample overall, and for subgroups defined by the type and duration of adult learning, the intensity and duration of adult learning, and mothers' prior educational qualifications at the 5% significance level.

Methodology

Data for this study came from the Avon Longitudinal Study of Parents and Children (ALSPAC), an ongoing population-based study of children born in the early 1990s, designed to investigate the effects of environmental, genetic and other influences on the health and development of children (Golding et al., 2001). Key stage exam results were merged into ALSPAC from the National Pupil Database (NPD) for this research.

We used KS3 mathematics and English test scores as two separate outcome variables. Raw scores achieved in English and mathematics were recalibrated using information from the key stage level achieved, and the tier at which the exam was taken (mathematics only) to produce a score in the form of a fraction of a level (a method developed by Levčić et al., 2005). Children's results in KS2 assessments were also obtained from the NPD to control for prior attainment.

Information on adult education came from a module on adult learning commissioned by the then Department for Education and Skills. From this module we obtained information on mothers' participation in learning between 2001 and 2004, i.e. prior to their children's KS3 tests. Matching the module data with NPD data produced a sample of 3,509 mothers. Of these, 79% participated in some form of learning and 21% did not. We also collected data on type of courses undertaken (accredited, unaccredited and informal learning), intensity (hours per week) and duration of learning. These data were weighted for non-response.

Background information about the mother, the children, interactions between mother and child, and the home learning environment were all obtained from ALSPAC and controlled for in our analyses, which were conducted using Ordinary Least Squares regression models.

Findings

We found no association between mothers' adult learning and their children's later KS3 attainment across the sample as a whole, once the effects of other observed factors – in particular mothers' previous education as measured by their highest qualifications achieved when their children were born – had been taken into account. All results also control for children's prior attainment at KS2, so our findings reflect whether or not mothers' adult learning experiences added value to their children's achievements between KS2 and KS3.

However, whole-sample relationships can mask differences between different subgroups. We therefore also investigated the relationship of mothers' adult learning to their child's later KS3 attainment for a number of different subgroups.

First, we examined whether different types of adult learning might have correspondingly different effects. We used a seven-fold classification based on

whether the adult learning undertaken led to qualifications, did not lead to qualifications, was informal or entailed a combination of these types. There were thus seven subgroups, defined by whether mothers had undertaken:

- learning leading to qualifications only;
- learning not leading to qualifications only;
- informal learning only;
- learning leading to qualifications and learning not leading to qualifications;
- learning not leading to qualifications and informal learning;
- informal learning and learning leading to qualifications;
- all types of learning.

For all groups at the 5% significance level, and for most at the 10% significance level, the participation of mothers in any other type of adult learning was not associated with a change in their children's KS3 test scores. The single exception was a combination of informal learning and learning not leading to qualifications, which showed an association significant at the 10% level. Given the result for other relationships we looked at, and the low level of significance in this case, we are unsure whether this association represents a genuine effect.

We went on to consider the evidence in relation to the intensity and duration of the learning experience of mothers, to investigate whether this might have a relationship with their children's school achievement. We used four different categories of intensity and duration:

- short duration (less than a week) – low weekly intensity (less than 5 hours a week);
- short duration (less than a week) – high weekly intensity (5 hours or more a week);
- long duration (a week or more) – low weekly intensity (less than 5 hours a week);
- long duration (a week or more) – high weekly intensity (5 hours or more a week).

Consistent with our previous findings for English and mathematics, initial indications of a possible association disappeared when full controls were included in the analysis.

Finally, we looked at the effects of adult learning for mothers with different levels of prior education, to see if adult learning might have an effect for children of mothers with already high (or low) levels of education. Mothers were classified according to whether, before the birth of their child, they had obtained:

- qualifications below O-level or equivalent;
- qualifications at O-level or equivalent;
- qualifications equivalent to or higher than A-level.

Again, this analysis did not produce any statistically significant associations between

mothers' adult learning and their children's later KS3 attainment.

Conclusions

The aim of this study was to investigate whether, all other things being equal, the children of mothers who engaged in adult learning achieved better results than those whose mothers did not. Our results suggest that, once we take into account the impact of the mothers' previous educational attainment, their participation in adult learning bears no additional benefit for their children's school achievement in KS3 tests.

On the face of it, this might suggest that it is mothers' initial schooling, rather than their adult learning, which is important for children's academic achievement. Indeed, other research provides evidence of the importance of parents' initial schooling. However, the results from this study do not necessarily imply that parents' adult learning is not important for children's schooling. This is because, with reference to the study's scope and data, there are a number of important limitations to our approach.

With regard to scope, we focused in this study on the adult learning of mothers and on the effects on their children's academic attainment at KS3 (age 14). There are therefore important aspects of the relationship between parents' adult learning and their children's achievement that we have not investigated, namely the effect of fathers' adult learning, and the effects of parental adult learning during other stages of their children's cognitive development. Bearing in mind children's increasing independence during adolescence, we would suggest that future research might focus on the role of parents' adult learning during their children's **pre-adolescent** development.

Our study is also limited by the nature of adult learning itself. As discussed by Feinstein and Sabates (2008), adult learning is characterised by a very wide range of providers, modes and types of provision, sources of funding and methods of accountability. This diversity itself makes the establishment of relationships difficult, and in this study we have been able to examine only general indicators of adult learning and their relationship with children's school achievement. It may be that some specific learning interventions – for instance particular family learning programmes – are very successful at raising children's school achievement. We cannot assume that results from the present study apply to particular learning interventions.

While perhaps in some sense disappointing, in that we do not find evidence of positive effects of mothers' learning on children's attainment at KS3, the results of our study do nevertheless provide valuable information and a useful foundation for future research.

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1. Introduction

The intergenerational transmission of educational success – the tendency of those with highly qualified parents to do well academically themselves – is a key driver in the persistence of social class differences in westernised societies such as the UK. In order to try and understand the role that education plays in the question of social mobility, one strand of research has focused on the causal effect of parental education on children's school attainments (see Holmlund, Lindahl and Plug, 2006, for a recent review of empirical studies). In general, results from this literature have shown a genuine causal effect of parental education that is independent of genetic inheritance. Many of these studies found that the size of the effect of parental education is modest, with differences by parental gender and social class.

This body of evidence, however, has tended to focus on the role of parental education measured as years of schooling or highest qualifications achieved. Typically, studies using these measurements of education do not differentiate years of schooling or highest qualifications achieved as a result of continuing progression in schooling from educational achievements in adulthood through adult learning. Although some work has started to emerge on the association between learning in adulthood and children's educational outcomes (Kaestner and Corman, 1995; Rosenzweig and Wolpin, 1994; Heydon and Reilly, 2007), the role and importance of adult learning remain relatively unexplored.

Results from the few studies that have tried to investigate the impact of adult learning on children's academic attainments are mixed. Evidence from the United States is inconclusive: in some cases, the authors found positive effects of adult learning on children's academic attainment (Rosenzweig and Wolpin, 1994); and in other cases, they found zero effects (Kaestner and Corman, 1995). By contrast, evidence from the UK appears to be more consistent and points towards the importance of adult learning for children's learning (Heydon and Reilly, 2007). However, these studies are less robust in their methodology than the US-based studies, in part due to a lack of suitable data.

The Avon Longitudinal Study of Parents and Children (ALSPAC) is the only large sample, longitudinal, UK survey that contains sufficient information on parents and children – including detailed adult learning histories, background and relevant context information, as well as child academic achievement data over time – to allow impacts of adult learning on children's developmental pathways to be modelled. In this study we examine the relationship between adult learning and later child attainment through the use of change models and rely on a rich set of covariates to ensure that we condition out the impact of observed confounding bias. These methods are commonly considered less robust in the estimation of causal effects of educational participation than other commonly used paradigms such as twin studies, natural experiments or matching methods (Blundell et al., 2005), but nonetheless offer a mechanism for getting a sense of the scale of possible effects.

This study explores the effect of mothers' learning during adulthood on the subsequent attainment of their children in terms of the following four questions:

1. What is the association between mothers' participation in adult education and children's value-added Key Stage 3 (age 14) English and mathematics test scores?¹
2. Does the relationship between adult learning and children's school attainment depend on type of adult learning course taken, in particular courses leading to qualifications, courses not leading to qualifications or informal learning?
3. To what extent is the time (measured by duration and frequency) spent in adult learning by mothers associated with their children's test scores?
4. Finally, does this relationship differ according to the educational background of mothers prior to their participation in learning (i.e. does adult learning moderate the association between mothers' prior education and children's school achievement)?

The rest of this report is organised as follows. Section 1.1 describes the theoretical framework for the intergenerational transmission of education. Section 1.2 reviews the empirical literature, with particular focus on studies aiming to estimate causal effects. Section 2 describes the data and variables used in the empirical model and sets out the methodological challenges. Results are presented in Section 3. Section 4 discusses the findings.

1.1 Theoretical framework

The topic of the intergenerational transmission of educational success and advantage is broad and diverse. It has been approached in different disciplines, with different methodologies, addressing subtly different research questions. Even within disciplines, authors adopt different empirical strategies. Researchers have used a great many different models to explore the influence of different features of family background on children's development. These different models control and test for different factors, in different combinations, in cross-sectional as well as longitudinal datasets.

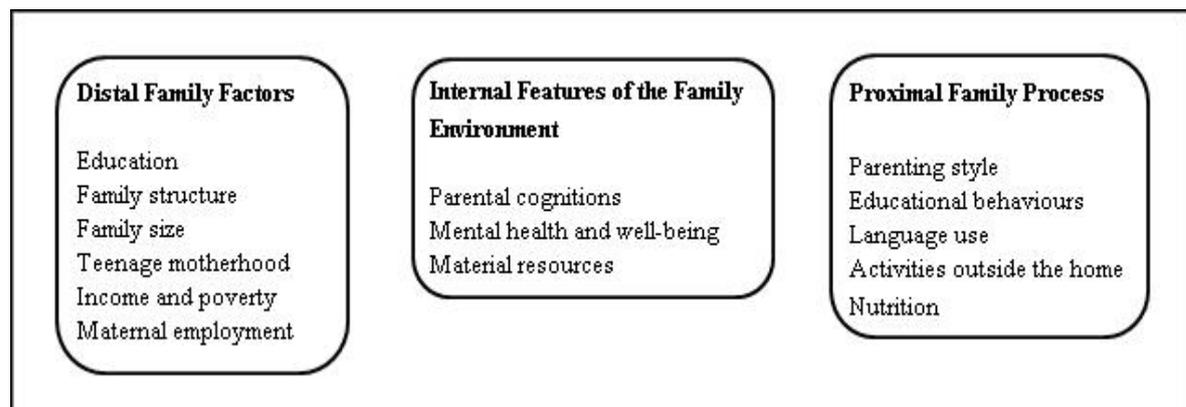
Understanding the possible relationships between parental education and children's academic attainment and the conceptual premises for the different ways in which parental education can result in benefits for their children is complex. In order to understand, model and quantify the role of education in this intergenerational transmission of advantage, we use a model of human development advanced by Uri Bronfenbrenner (1979, 1986; Bronfenbrenner and Morris, 2006). Bronfenbrenner's model conceptualises human development as the dynamic interactions between individuals and the multi-layered environments they inhabit (see also Baltes, 1987; Elder, 1998; Lerner, 1984, 1998; Magnusson and Stattin, 1998; Sameroff, 1983). This approach sees individual lives as encompassed within a set of nested structures and

¹ 'Value-added' in this case refers to changes in test scores over time, which can be obtained with information on previous academic attainment, for example KS2 or KS1 test scores.

differentiates between the **proximal** environment that is directly experienced by the individual (e.g. the family context) and the more **distal** cultural, social and economic systems that have an indirect effect on the individual, which are often mediated by the more proximal context. The great advantage of such an approach is that it allows for a focus on relationships between the many important factors, rather than a simple list of influences, and so it provides a useful framework for understanding how multiple factors influence individual adjustment.

Feinstein, Duckworth and Sabates (2004, 2008) used Bronfenbrenner’s ideas to develop a framework for the impact of parental education on children’s educational attainment. Like Bronfenbrenner’s, their model makes explicit the distinctions between family relationships, individual and family-level characteristics, as well as wider social and economic circumstances. More specifically, it distinguishes between three categories of family-level influences on children’s developmental outcomes: distal family factors; internal characteristics of the family environment; and proximal processes within the family (for similar family-level distinctions, see also Gottfried and Gottfried, 1984; Gottfried et al., 1994). These categories and examples of specific influences in the context of the family are shown in Figure 1 below.

Figure 1: Three categories of family-level influences on child development



In the Bronfenbrenner’s model, distal family factors are the more global or descriptive factors that characterise the wider environment of the child and provide an index of a family’s demographic or socio-economic situation. Examples of distal family factors include income or parents’ occupation. Internal features of the family context are more closely related to the proximal factors that impact on children, mediating the impact of wider contextual family factors on the experience of the child. Important internal characteristics of the family environment include the availability of resources, such as cognitively enriching and stimulating materials and activities, parental cognitions (an umbrella term to refer to attitudes, aspirations, expectations, values and beliefs, etc.), parents’ mental health, well-being and network supports, as well as the physical infrastructure of the home.

The model developed by Feinstein, Duckworth and Sabates (2004 and 2008) clarifies the importance of education as a specific distal factor and lays out a number of ways

in which parents' education may impact on a number of different measures of children's development, both directly and indirectly, through other mediating features of the distal and proximal environment outlined in the ecological model developed by Bronfenbrenner. Thus, although in Figure 1 parents' education is grouped with distal family factors, such as income, family size and structure and teenage motherhood, it has a particular importance in that it influences each of these distal factors themselves as well as having both direct and indirect relationships with the internal features of the family and the proximal family processes.

These pathways can be summarised by two central hypotheses. Parents' education may matter because:

- it impacts on, i.e. is mediated by, other important factors that, in turn, influence children's development;
- it moderates the effects of these other factors, i.e. changes the way in which they operate.

To clarify these two hypotheses, Feinstein, Duckworth and Sabates (2008) used parental income as an example of a distal factor. Parents' education has a direct effect on family income and, in turn, income has an effect on children's school achievement. Therefore, some of the effect of income on children's achievement is, in a sense, an effect of prior parental education. This is a mediated effect. They also explained that parents with higher levels of education may spend a given amount of income differently from those with lower education, and so may be better able to protect children against the effects of poverty or to derive greater developmental advantages from high income. This is a moderating effect.

1.2 Empirical studies

It is commonly observed that children of parents with higher levels of education do better in standard tests of school attainment than those of parents with less education (Feinstein and Duckworth, 2006; Bynner and Joshi, 2002; Feinstein, Robertson and Symons, 1999; Gregg and Machin, 2000; Haveman and Wolfe, 1995; Klebanov, Brooks-Gunn and Duncan, 1994; Smith, Brooks-Gunn and Klebanov, 1997). Higher levels of maternal education have been consistently linked to their children's tests of academic attainment and school grades (Alexander, Entwistle and Bedinger, 1994; Davis-Kean, Eccles and Schnabel, 2002; Alexander and Entwistle, 1988; Ensminger and Slusarick, 1992; Haveman and Wolfe, 1995; Smith, 1989) and young children's school readiness (Christian, Morrison and Bryant, 1998; Seefeldt et al., 1999). Moreover, Magnuson (2003) finds that in the US, an increase in maternal education among mothers with low levels of prior educational qualifications is associated with a positive change in their children's academic achievement.

Evidence from the UK has shown that parental education has a significant impact on the school achievement of adopted children. Dearden, Machin and Reed (1997), for example, showed that the impact of fathers' schooling on adopted sons' schooling

was almost as large as the impact of fathers' schooling on their own children's schooling. Sacerdote (2000) used data from the National Child Development Study (NCDS) in the UK and found that the level of household education had as large effects on children's university attendance for adopted children as for natural children.

Galindo-Rueda (2003) exploited the change in compulsory school-leaving age made by the 1947 education reform, which raised the age at which pupils could leave school from 14 to 15 years, to identify the impact of parental education. He used data from parents of the cohort born in 1958 (NCDS). His results showed that, for parents most affected by the policy change, i.e. those who left school at the earliest possible opportunity, the additional year of education resulted in positive effects of fathers' education on school attainment of their sons, but not for their daughters. Chevalier (2004) used data from the British Family Resource Survey and the next change in school-leaving age imposed by the 1973 reform, which raised the end of compulsory schooling to 16. In contrast to those of Galindo-Rueda, Chevalier found positive effects of mothers' education on children's school attainment and small or insignificant effects of fathers' education.

The evidence reviewed above suggests important effects of parental education on their children's achievements, although it is unclear whether this is an effect of fathers' or of mothers' education and for the most part there is no distinction as to when this education is achieved. Little empirical evidence has focused specifically on the intergenerational effects of **adult** learning. The very few studies that have investigated the role of adult learning have either focused on basic skills during adulthood – thus examining adult **capabilities** rather than necessarily adult learning – or have used information on parents who return to learning to be able to isolate the impact of adult learning from that of previous learning.

As an example of the former approach, evidence from the UK has shown that adults with poor literacy and numeracy skills have children who fare worse academically than other children (Bynner and Parsons, 2006). De Coulon, Meschi and Vignoles (2008) assessed the impact of parents' basic skills in literacy and numeracy on their children's cognitive outcomes using data from the 1970 British Cohort. Their results showed a positive and significant relationship between parents' skills in literacy and numeracy and their children's cognitive development over and above the impact of highest qualifications achieved by parents. They further found that this positive relationship was stronger for parents with low levels of qualifications, indicating the importance of cognitive capabilities in adulthood for children who might be at risk of not doing so well in school.

Examples of the latter approach come primarily from the USA. Kaestner and Corman (1995) reported the association of young children's improvements on tests of reading and mathematics over a two-year period with increases in their mother's formal education during this time. They found no apparent effect of increased maternal education on children's achievement scores. However, Rosenzweig and Wolpin (1994), also in the United States, looked at differences in test scores between earlier-

born and later-born pairs of siblings, relating these differences to increases in their mother's formal education over the intervening period. They found that an additional year of maternal education had a modestly positive and significant effect on their children's achievement in reading and mathematics tests, although not on a measure of verbal IQ. The evidence from the USA is thus somewhat contradictory, if possibly explained by differences in research method.

In the UK, there is additional literature evaluating the effects of particular adult learning initiatives. The project Realising Early Achievement in Literacy compared the progress of children in a family learning group (where parents were engaged in reflecting on their role of supporting children's development, alongside teachers and parents sharing information about children's learning) with that of children in a control group. The children in the family learning group made significantly greater gains in test scores than those in the control group (Heydon and Reilly, 2007). The evaluation of another family learning programme, the Family Literacy Pilot Project, showed that improvements in children's reading attainment were likely to be linked to improvements in the parents' literacy levels (Brooks et al., 1996). Other programmes have proved to have important benefits for parents in terms of engaging in learning and improving on basic skills, for example the Adult Minorities Breaking Educational Restrictions and SHARE (a school programme where parents work with children at home), but the benefits for children's educational attainment were not evaluated.

In summary, there is an extensive body of research which shows that children of parents with longer participation in education do better in standard tests of school attainment than those whose parents have had less education. Some studies have pointed out the importance of participation in education for individuals who missed out during schooling for their children's school performance. However, due to a lack of comprehensive, longitudinal data on adult learning and children's development, very few studies have thoroughly investigated the association between adult learning and children's academic attainment. This is the aim of the current research.

2. Method

2.1 Data

The Avon Longitudinal Study of Parents and Children (ALSPAC) is an ongoing population-based study designed to investigate the effects of environmental, genetic and other influences on the health and development of children (Golding *et al.*, 2001). Eligible participants were those pregnant women resident in the former Avon Health Authority in south-west England who were expected to deliver between 1 April 1991 and 31 December 1992. Approximately 85% of the eligible women enrolled, establishing a cohort of 14,541 pregnant women resulting in 13,971 children (alive at 12 months of age). The primary source of data collection was via self-completion questionnaires administered during pregnancy and at various ages of the child.

In 2004, the Department for Education and Skills (DfES) commissioned a questionnaire module on adult learning, which was sent to parents in the ALSPAC study in 2004. Parents were asked about their adult learning training undertaken between 2001 and 2004. Information was collected about reasons for, and engagement with, learning, as well as duration, type and outcomes of learning. The ultimate aim of this survey was to gain a better understanding of the relationship between parental education and learning and children's social and educational development. Questionnaires were sent out to all carers who agreed to answer questionnaires. Of the 9,773 questionnaires sent out, 5,376 were completed and returned.²

National Curriculum key stage scores from the National Pupil Database (NPD) were matched to the children participants of ALSPAC. Successful matches were obtained for 3,509 children, 65% of the 5,376 mothers who completed the adult learning questionnaire. This is our estimation sample. It excludes, in particular, pupils from private schools and those not living in England.

The ALSPAC dataset, with its questionnaire module on adult learning and its recent links to test scores using the NPD, is perhaps the best dataset to test the impact of adult learning on children's school attainment. It is unlikely that better data currently exist in the UK for the purposes of this study.

2.2 Variables

Outcome variable: school attainment

We use the Key Stage 3 (KS3) test scores from the education authorities to assess

² A descriptive analysis of the survey is given in DfES (2006) *Avon Longitudinal Study of Parents and Children (ALSPAC): Adult learning and families* (www.dcsf.gov.uk/research/data/uploadfiles/RBX02-06.pdf)

children's school attainment. There are three assessments at KS3: English, mathematics and science. In this report we focus exclusively on English and mathematics attainment. KS3 assessments are administered at the end of Year 9, when most children are 13 or 14 years old. Children in this sample will thus have taken their KS3 tests in the period May 2005 to May 2007.

For estimation purposes, raw scores achieved in English and mathematics were recalibrated using information from the key stage level achieved and the tier at which the exam was taken (only for mathematics) to produce a score in fraction of a level (method developed by Levāčić *et al.*, 2005). Recalibration for mathematics scores is extremely important, as it takes into account the tier at which pupils enter the exam and these tiers influence the potential maximum score for these pupils.³ The recalibration also means that each level equals 1.0 regardless of the level or the tier taken. Government targets suggest that pupils should make one level of progress every two years. Therefore, an estimated coefficient of 1.0 is equivalent to 24 months of 'progress'; a coefficient of 0.5 would be equivalent to one year of progress.

In order to investigate a value-added model on KS3 test scores, we needed a measurement of prior attainment. We used KS2 assessments on English and mathematics administered at the end of Year 6, when children were 10 to 11 years, as measurements of prior attainment for English and mathematics respectively. KS2 raw scores were also recalibrated following the methodology of Levāčić *et al.* (2005).

Adult learning data

The adult learning survey for ALSPAC contains information on participation, engagement and duration of learning, reasons for learning and outcomes of learning. There is also information on individuals' attitudes towards learning while in school, which is a key control used in our analysis.

Participation in learning data were collected on mothers' learning between 2001 and 2004 (79% of mothers participated in some form of learning and 21% did not). This included courses leading to qualifications (taken by 44% of mothers), courses not intended to lead to any qualification (65% of mothers) or learning activities which were not part of an organised course, which we call 'informal learning' (58% of mothers). These categories were not mutually exclusive, so we generated a more refined indicator of participation in learning, which differentiates between the following seven options:

- courses leading to qualifications only (4.8% of mothers who participated in learning);
- courses not leading to qualifications only (9.3% of mothers who participated in learning);

³ Tiers in KS3 mathematics scores define the level of difficulty. Achieving 40 points in raw score in mathematics in tier 1 and 40 points in raw score in tier 3 does not imply that these two scores are the same. The adjustment is needed to sort pupils according to their mathematical ability.

- participation in informal learning only (9.1% of mothers who participated in learning);
- courses leading **and** not leading to qualifications (9.6% of mothers who participated in learning);
- courses not leading to qualifications **and** informal learning (25.2% of mothers who participated in learning);
- courses leading to qualifications **and** informal learning (5.0% of mothers who participated in learning);
- participation in all types of learning (37.0% of mothers who participated in learning).

Time spent in learning data had two dimensions of measurement: duration of the course and weekly engagement. Duration of learning was measured by the longest learning spell. Of those mothers engaged in learning, 33% reported duration of less than one week, 13% between one week and three months, 24% between three months and one year, 13% between one and two years, and 17% over two years. Weekly engagement in learning was measured by the maximum number of hours a week that the mother spent learning, which included attending classes, doing homework and studying. Half of mothers who did learning spent less than five hours a week engaged in learning, 25% between five and nine hours, 12% between ten and 19 hours, and 12% spent 20 or more hours. We defined ‘short duration’ as courses lasting less than one week; ‘long duration’ as courses lasting a week or more; and ‘low weekly engagement’ as less than five hours a week devoted to learning. These two indicators (duration and weekly engagement) were combined to generate four different categories:

- short duration-low weekly engagement (24.2% of mothers who participated in learning);
- short duration-high weekly engagement (8.5% of mothers);
- long duration-low weekly engagement (27.9% of mothers);
- long duration-high weekly engagement (39.4% of mothers).

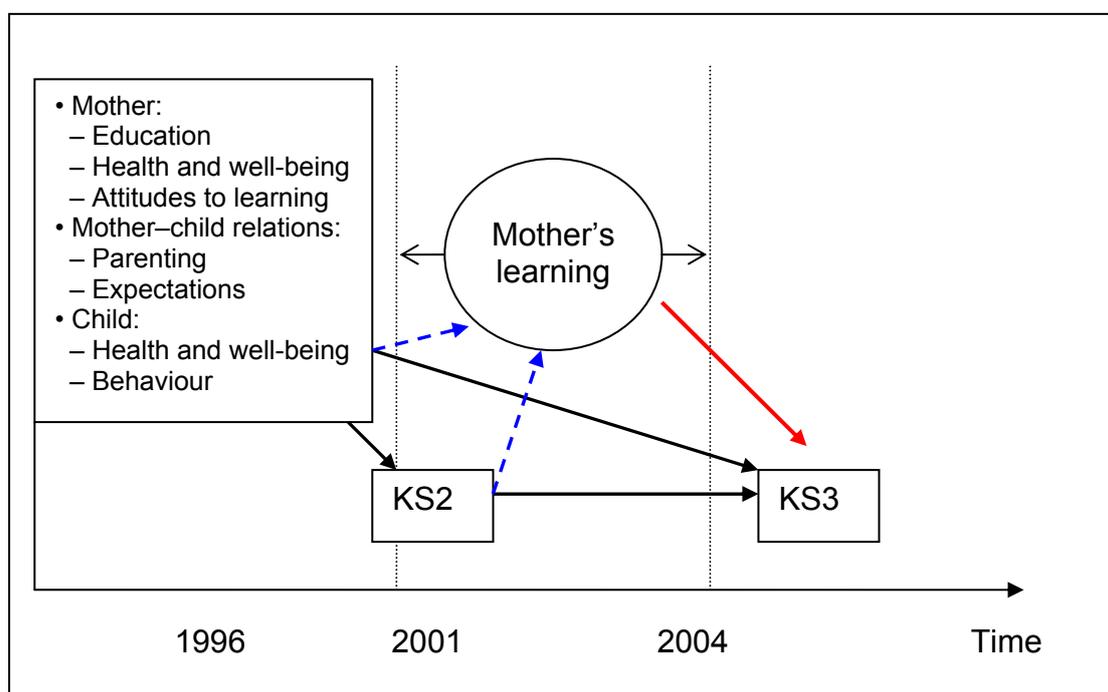
Observable control variables

Figure 2 presents a schematic representation of the inclusion of controls available in the ALSPAC dataset. Time is shown along the x-axis. Mothers’ participation in learning took place between 2001 and 2004 and their children sat KS3 exams after this time.

Following our theoretical model, we introduced as controls the mother’s **socio-demographic background factors**, including her highest level of qualifications reported when the child was born (between April 1991 and December 1992), her socio-economic and employment status prior to 2001, plus more ‘historical’ measures, such as her family social origins, her family size when she was a child, type of

housing she lived in, number of financial difficulties faced, among others.⁴

Figure 2: Schematic representation of the inclusion of control variables



The richness of the ALSPAC dataset also allows us to include measures of **mothers' mental health and attitudes**, including locus of control, self-esteem, self-reported health, attitudes to school and attitudes to learning while in school. These variables are important, because these may be factors influencing why mothers participate in education.

We also included measures of **parent-child relationships⁵ and the home learning environment.⁶** Mother-child interactions were measured using the summed responses to questions about how frequently they sing and read to/with their children, play with them and try to teach them colours, letters and nursery rhymes, etc. Questions regarding the number of books and toys in the home were also asked. All these variables pre-dated the mothers' experience of adult learning.

Background information about the child was also used, not only because it is important as a predictor of school attainment, e.g. health in early childhood predicts later school attainment, but also because mothers may choose to participate in adult education because their child is facing difficulties with his/her academic, behavioural or physical development. In addition to the measures of earlier school attainment outlined above, we include pre-school measures of social and personal development, fine and gross motor development, temperament, and physical development. Age and gender were also included in all models.

⁴ All these factors are distal variables in our theoretical model.

⁵ Proximal family processes in our theoretical model.

⁶ Characteristics of the home context in our theoretical model.

Finally, **school variables** are likely to have an impact on attainment. We included information about the type of school and we differentiated between community schools, voluntary schools (both aided and controlled) and other types of school (city technology colleges, non-maintained special schools, academies, and colleges of further education).

Further details on the full set of control variables can be found in the Appendix.

2.3 Methodological challenges

There are several methodological issues that were considered for this study.

First, the timing of events is important to assess the links from adult learning to children's school attainment. As shown in Figure 2, the measured adult maternal learning experience (2001 to 2004) occurred prior to the child's KS3 attainments, which took place between 2005 (for the oldest cohort) and 2007 (for the youngest cohort).

Second, children's current school attainment depends heavily on their previous school performance. Research by the Effectiveness Pre-school and Primary Education 3–11 project (EPPE 3–11) (Melhuish *et al.*, 2006) highlights the high degree of stability in pupils' trajectories over the course of primary school. Similarly, Duckworth (2007) has shown that KS1 attainment predicts up to 50% of the variation in KS2 attainment. In addition, research by Duckworth (2008) has also shown a greater potential for test score improvement at the lower ends of the test score distribution. We thus need to condition out the effects of prior attainment and so included KS2 scores as controls. Therefore, our outcome variable can be interpreted as **change** in attainment between KS2 and KS3, rather than as a simple KS3 score.

Third, attrition has led to the under- or over-representation of certain groups. Mothers with higher levels of education were more likely to return the questionnaire complete. A similar bias was found with respect to socio-economic status. White women were also more likely than mothers from other ethnic groups to return a completed questionnaire.⁷ There are several methods to condition out this type of bias. In this report, we generated response weights using the propensity score methodology. The propensity score is the conditional probability of receiving a given exposure (in this case, returning a complete questionnaire), given a set of measured characteristics. Observable characteristics of mothers in the data were obtained exclusively from the questionnaire administered during the thirty-second week of pregnancy. This was done to avoid further bias due to attrition in subsequent sweeps. There were, however, 304 mothers who completed the adult learning questionnaire but who did not complete the pregnancy questionnaire. These women were not included in the

⁷ Biases were assessed using mothers only, since the mother was the key figure for sampling frame and design. Eligibility for the ALSPAC study was based on mothers' residence, pregnancy status and delivery dates. Partners were part of the study only if mothers were.

re-weighted estimates of this report as we do not have any basis on which to analyse sources of potential bias for this group.⁸

The propensity score reduces the baseline information to a single composite summary of these observed characteristics. This single composite summary was used to re-weight observations to make them representative of the population of interest. For example, a mother with higher levels of education and who belongs to the highest socio-economic group will have a higher propensity score of returning a complete questionnaire than a mother with low levels of education and from the lowest socio-economic groups. As a result, the weight given to the high education/high occupational group women will be lower than the one to the low education/low occupational group women.

Fourth, it is important to take into account the clustering of pupils in schools. To deal with this issue, robust standard errors were estimated.

And finally, we wanted to establish a proper control group to compare with the impact of mothers' adult learning on their children's KS3 attainments. However, even after the inclusion of response weights and controlling for previous attainment, mothers who did some form of adult learning may be systematically different from mothers who did not. These systematic differences could also affect children's KS3 attainments. Therefore, an estimate of the impact of adult learning could still suffer from bias. The richness of information about the mother and the child that has been collected in ALSPAC is thus used to control for observable sources of possible confounding bias.

2.4 Estimation method

We estimated the impact of mothers' participation in any learning activity between 2001 and 2004 on their children's KS3 exam results using Ordinary Least Squares (OLS) regression techniques (Wooldridge, 2002). All regressions were performed separately for English and mathematics test scores and weighted by response weights to the adult learning survey.

We start each regression, including only a basic specification for KS3 attainments, by conditioning out the impact of prior attainment, gender and age and to estimate the association of adult learning. We then introduce mothers' highest prior educational qualifications and investigated how much of the estimated relationship between adult learning and KS3 scores is accounted for by this. We next incorporate mothers' attitudes towards school learning, health and well-being, as well as other socio-economic background factors of the mother. In the full model specification, we

⁸ There was also a slight bias with respect to the education of the mothers who were sent the adult learning survey (mothers with higher levels of education were more likely to be sent the survey). We used this information when calculating weights using the propensity score: $\text{Weight} = 1 / \text{Probability}(\text{sent questionnaire}) * \text{Probability}(\text{completed questionnaire})$.

include all information regarding the mother–child relations, as well as the child’s earlier developmental information, which could account for bias in the estimation of the adult learning parameters.

We then focus on features of mothers’ learning, in particular type of learning and duration. To do this, we break down the single binary measure of participation in adult learning into a series of possible forms of participation and re-estimate models. We also break down the variable into duration and engagement in learning and re-estimate the models for which we found significant associations between adult learning and children’s school attainment.

Finally, because prior qualifications are such an important explanatory factor in predicting children’s school attainment and adult learning, and because we are interested in the role of adult learning in reducing the attainment gap, we divide the sample by level of maternal qualification and re-estimate the models. Three models were re-estimated:

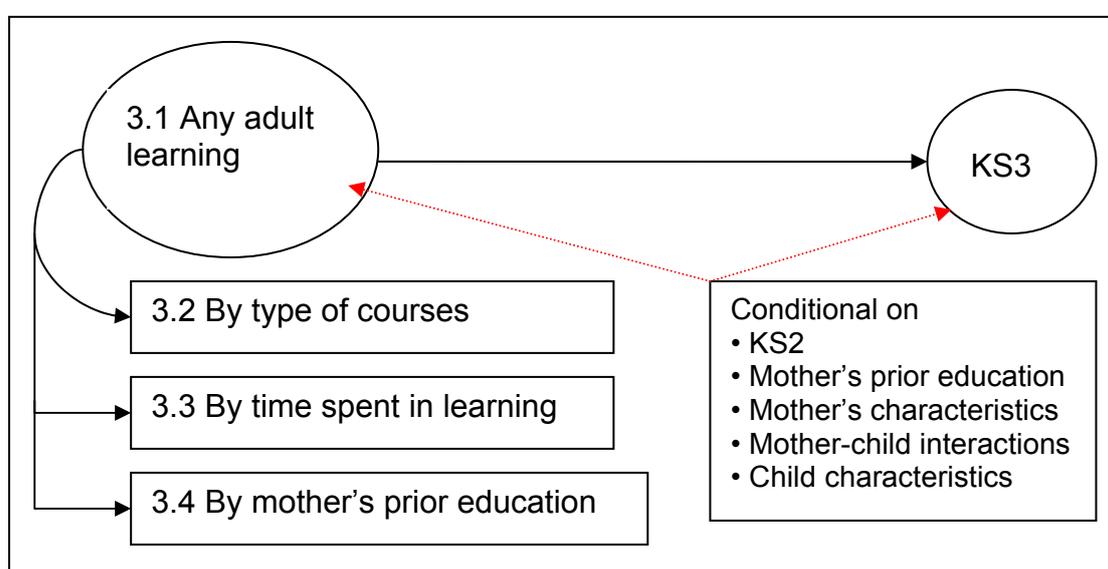
- for mothers who by 1992 had achieved CSE, vocational or lower levels of qualifications (including no qualifications);
- for mothers who had achieved O-levels;
- for mothers who had achieved A-levels or higher levels of qualifications.

The aim in this study is to investigate whether there are greater associations of adult learning with children’s school attainment for mothers with the lowest prior school qualifications.

3. Results

Figure 3 shows the order and structure of analyses presented in this report. Section 3.1 presents results on the role of mothers' participation in any form of adult learning on children's KS2 to KS3 progress conditional on all of the observable factors. Section 3.2 presents results from the model using participation in different types of courses by mothers. Section 3.3 investigates whether time spent in learning by mothers has any association with their children's school attainment. Finally, Section 3.4 focuses on how results change if we re-estimate separate models according to mothers' prior educational qualifications.

Figure 3: Schematic representation of results



3.1 The association of mothers' learning and children's Key Stage 3 scores

Table 1 shows the results of the regression analysis to assess the association of mothers' participation in any adult learning between 2001 and 2004 and their children's KS3 English scores (see figures in bold). The parameters given in the table can be translated in terms of months of progress (a parameter equal to 1.0 is equivalent to 24 months of progress). Thus, a simple association with no controls (base case) yields a regression coefficient of 0.14, showing that children whose mothers did participate in adult learning obtained English scores that were, on average, three months of progress ahead of children whose mothers did not. However, as successive controls are introduced (mothers' prior education, mothers' socio-demographic and other family background characteristics, mother-child relationships and child's prior development), the strength of the association is reduced to statistical insignificance, showing that the apparent relationship is actually accounted for by other factors, in particular mothers' prior educational qualifications.

Table 1: OLS Parameter estimate [standard error] of the impact of mothers' participation in learning on children's KS3 English attainment

Coefficient	Base case	Mother's education	Mother's characteristics	Full controls
Any Adult Learning	0.136** [0.055]	0.059 [0.047]	0.016 [0.042]	0.001 [0.040]
KS2 English	0.965*** [0.047]	0.926*** [0.049]	0.922*** [0.039]	0.920*** [0.036]
Gender (girls)	0.206*** [0.040]	0.227*** [0.041]	0.223*** [0.031]	0.203*** [0.046]
Age	-0.003*** [0.001]	-0.003** [0.001]	-0.002* [0.001]	-0.001 [0.001]
Mothers' edu (O-level)		0.118** [0.054]	0.110** [0.050]	0.0659 [0.045]
Mothers' edu (A-level+)		0.285*** [0.056]	0.260*** [0.053]	0.185*** [0.050]
Constant	2.294*** [0.411]	2.367*** [0.436]	2.606*** [0.386]	1.321** [0.648]
Mother's characteristics	No	No	Yes	Yes
Mother-child interactions	No	No	No	Yes
Child characteristics	No	No	No	Yes
R-squared	0.59	0.60	0.63	0.65

Source: ALSPAC. Notes: Robust standard errors in brackets. Asterisks *, **, *** indicate significance at 10%, 5% and 1% level respectively. All estimations are weighted by response weights. Sample size: 3,092.

Turning to the effects of mothers' adult learning on mathematics KS3 scores (Table 2, figures in bold), we find that mothers who participated in learning between 2001 and 2004 had children who made, on average, two months of additional progress compared with children of mothers who did not participate in learning (parameter of 0.10). However, with the inclusion of controls, and particularly of mothers' prior education, this parameter is reduced and becomes statistically insignificant.

Table 2: OLS Parameter estimate [standard error] of the impact of mothers' participation in learning on children's KS3 mathematics attainment

Coefficient	Base case	Mother's education	Mother's characteristics	Full controls
Any Adult Learning	0.102* [0.055]	0.006 [0.055]	-0.042 [0.046]	-0.041 [0.041]
KS2 Mathematics	1.261*** [0.060]	1.218*** [0.056]	1.182*** [0.045]	1.154*** [0.043]
Gender (girls)	-0.017 [0.047]	0.000 [0.042]	0.014 [0.032]	0.062 [0.052]
Age	-0.0011 [0.0016]	-0.0010 [0.0014]	-0.0002 [0.0010]	-0.0005 [0.0009]
Mother's edu (O-level)		0.219*** [0.065]	0.157*** [0.051]	0.104** [0.046]
Mothers' edu (A-level+)		0.406*** [0.060]	0.268*** [0.051]	0.153*** [0.047]
Constant	0.886* [0.481]	0.893** [0.437]	1.256*** [0.399]	1.055* [0.592]
Mother's characteristics	No	No	Yes	Yes
Mother-child interactions	No	No	No	Yes
Child characteristics	No	No	No	Yes
R-squared	0.73	0.75	0.76	0.78

Source: ALSPAC. Notes: Robust standard errors in brackets. Asterisks *, **, *** indicate significance at 10%, 5% and 1% level respectively. All estimations are weighted by response weights. Sample size: 3,254.

3.2 The role of type of learning

We also investigated the impact of type of adult learning on children's school attainment using a seven-fold classification based on whether the adult learning undertaken led to qualifications, did not lead to qualifications, was informal or entailed a combination of these different types. See Section 2.2 for a fuller account of these measures.

Table 3 shows the association of each of these types of learning activities on children's KS3 school attainment. The comparison group is always mothers who did not participate in learning. For both English and mathematics scores we first estimated the basic specification model that includes only controls for prior attainment, age and gender (base case). We then included the mother's prior qualifications (mother's education) and finally the model with all controls (full).

As before, although initial models indicated possible relationships between mothers' participation in adult learning and their children's KS3 English and mathematics scores, inclusion of full controls reduced the effects to a level at which they became

statistically insignificant for all forms of adult learning except for unaccredited and informal learning (only significant at the 10% level). For this, we found that children whose mothers did unaccredited courses combined with informal learning achieved, on average, two months of additional progress in KS3 English compared with those whose mothers did not participate in learning. There was no association with improved mathematics scores.

Table 3: OLS Parameter estimate [standard error] of the impact of type of adult learning undertaken by mothers on children’s KS3 attainment (English and mathematics)

	ENGLISH			MATHEMATICS		
	Base case	Mother’s education	full	Base case	Mother’s education	full
<i>Type of learning vs. no learning</i>						
Quals only	0.028 [0.073]	0.001 [0.064]	-0.03 [0.066]	0.046 [0.069]	0.012 [0.065]	-0.028 [0.065]
Quals/no quals	0.126 [0.087]	0.081 [0.089]	0 [0.067]	0.056 [0.078]	0.006 [0.068]	-0.061 [0.065]
All types	0.084 [0.062]	0.005 [0.054]	-0.041 [0.049]	0.118** [0.055]	0.005 [0.055]	-0.064 [0.049]
No quals only	0.035 [0.071]	-0.036 [0.062]	-0.059 [0.062]	0.068 [0.061]	-0.024 [0.061]	-0.069 [0.052]
No quals/informal	0.266*** [0.062]	0.171*** [0.059]	0.089* [0.050]	0.118 [0.113]	0.000 [0.110]	0.008 [0.050]
Informal only	0.149** [0.060]	0.087* [0.050]	0.048 [0.048]	0.086 [0.063]	0.018 [0.060]	-0.054 [0.054]
Informal/quals	0.097 [0.070]	0.006 [0.066]	-0.022 [0.060]	0.167*** [0.065]	0.062 [0.070]	0.038 [0.072]
Observations	3134	3134	3092	3296	3296	3254
R-squared	0.60	0.61	0.65	0.73	0.75	0.78
Children’s prior attainment	Yes	Yes	Yes	Yes	Yes	Yes
Mother’s characteristics	No	No	Yes	No	No	Yes
Mother–child interactions	No	No	Yes	No	No	Yes
Child characteristics	No	No	Yes	No	No	Yes

Source: ALSPAC. Notes: Robust standard errors in brackets. Asterisks *, **, *** indicate significance at 10%, 5% and 1% level respectively. All estimations are weighted by response weights. Category for comparison for ‘type of learning’ is ‘no learning’.

3.3 The role of time spent in learning (weekly hours engaged in learning and course duration)

Although there is very little evidence to support the association between adult learning and children’s KS3 attainment, we wanted to consider the evidence in

relation to the intensity and duration of the learning, to investigate whether this might have a bearing on its effects.

To examine this aspect, we generated four different categories of intensity and duration:

- short duration-low weekly engagement;
- short duration-high weekly engagement;
- long duration-low weekly engagement;
- long duration-high weekly engagement.

See Section 2.2 for further details of these measures.

Table 4 shows the results of the estimated association of mothers' time spent in learning on their children's KS3 test scores. Again, consistent with our other results for English and mathematics, initial indications of a possible association disappeared when full controls were included.

Table 4: OLS Parameter estimate [standard error] of the impact of mothers' time engaged in learning on children's KS3 attainment (English and mathematics)

	ENGLISH			MATHEMATICS		
	Base case	Mother's education	full	Base case	Mother's education	full
<i>Time spent in learning vs. no learning</i>						
Short duration-low weekly engagement	0.184*** [0.066]	0.126** [0.061]	0.042 [0.048]	0.011 [0.094]	-0.046 [0.088]	-0.042 [0.049]
Short duration-high weekly engagement	0.229*** [0.063]	0.151** [0.060]	0.084 [0.054]	0.142** [0.063]	0.051 [0.062]	-0.027 [0.059]
Long duration-low weekly engagement	0.123** [0.058]	0.026 [0.049]	-0.017 [0.047]	0.205*** [0.052]	0.084 [0.052]	0.021 [0.045]
Long duration-high weekly engagement	0.088 [0.060]	0.004 [0.051]	-0.038 [0.048]	0.099* [0.051]	-0.005 [0.051]	-0.078 [0.048]
Observations	3134	3134	3092	3296	3296	3254
R-squared	0.59	0.61	0.65	0.73	0.75	0.78
Children's prior attainment	Yes	Yes	Yes	Yes	Yes	Yes
Mother's characteristics	No	No	Yes	No	No	Yes
Mother-child interactions	No	No	Yes	No	No	Yes
Child characteristics	No	No	Yes	No	No	Yes

Source: ALSPAC. Notes: Robust standard errors in brackets. Asterisks *, **, *** indicate significance at 10%, 5% and 1% level respectively. All estimations are weighted by response weights. Category for comparison for 'time spent in learning' is 'no learning'.

3.4 The role of mothers' prior education

A key tenet of educational and family policy is supporting disadvantaged families. We therefore wished to examine how results varied for those with different levels of qualification. Mothers' educational qualifications were divided into:

- achieving low-level qualifications: a CSE examination, low-level vocational qualifications or other low-level qualifications (19% of the sample)
- achieving mid-range qualifications: O-levels (40% of the sample)
- achieving high-level qualifications: A-levels, degrees or higher degrees (41% of the sample).

Table 5 shows the estimated association of adult learning and KS3 scores in English and mathematics examinations by mothers' prior educational qualifications.

Still, our results showed that there is no significant relationship between mothers' participation in adult learning and their children's later KS3 attainment for English or mathematics according to mothers' prior educational qualifications.

Table 5: OLS Parameter estimate [standard error] of the impact of mothers' learning on children's KS3 attainment by mothers' prior educational qualifications

	Mother's CSE and vocational education		Mother's O-level		Mother's A-level+	
	Base case	full	Base case	full	Base case	full
KS3 ENGLISH						
Any Adult Learning	0.028 [0.074]	-0.061 [0.081]	0.006 [0.052]	-0.082 [0.056]	0.087 [0.071]	0.083 [0.065]
No. Obs.	584	578	1237	1221	1198	1189
R-squared	0.64	0.74	0.59	0.64	0.52	0.59
KS3 MATHEMATICS						
Any Adult Learning	-0.191 [0.120]	-0.110 [0.071]	0.046 [0.064]	0.049 [0.049]	-0.049 [0.068]	-0.084 [0.054]
No. Obs.	609	603	1289	1273	1281	1272
R-squared	0.67	0.80	0.73	0.78	0.77	0.82
Children prior attainment	Yes	Yes	Yes	Yes	Yes	Yes
Mother's characteristics	No	Yes	No	Yes	No	Yes
Mother-child interactions	No	Yes	No	Yes	No	Yes
Child characteristics	No	Yes	No	Yes	No	Yes

Source: ALSPAC. Notes: Robust standard errors in brackets. Asterisks *, **, *** indicate significance at 10%, 5% and 1% level respectively. All estimations are weighted by response weights.

4. Discussion

Parental education is theorised as one of the key factors that can promote children's academic development and educational success. Evidence shows that children of parents with high levels of educational qualifications, or whose parents spent longer in education, achieve higher school grades than children whose parents have lower levels of education. For example, among ALSPAC children, the difference in the average KS3 mathematics scores between children whose parents achieved A-levels or higher qualifications compared with those whose parents achieved less than O-levels is 1.17 points in the recalibrated scale, which represents a little more than one year of progress in KS3 mathematics. Empirical studies, using sophisticated analytical techniques and complex research designs, have concluded that parental education, measured as years of schooling or highest qualifications achieved, do have indeed a causal impact on children's educational achievement.

Although this evidence is extremely relevant for both theory and policy, it focuses largely on education defined as highest educational qualifications or the total number of completed years of schooling. In the UK context, where a significant minority of the population still leaves the educational system without educational qualifications, the notion that parental education leads to a host of additional benefits for their children needs to be analysed over the lifecourse. Are there benefits of education over and beyond the achievement of educational qualifications? Are there greater returns for the children of parents with low levels of education who engage in learning as adults than for children of parents with high levels of education who also participate in learning? Very few studies have investigated these issues, therefore leaving an important gap in the evidence-based educational policy and a potentially valuable lever in reducing educational inequalities.

This study addresses a simple question: is mothers' learning in adulthood associated with gains in their children's school performance at age 14? The answer appears to be no for mathematics and English KS3 test scores. In most of our models, once we included information on mothers' prior educational qualifications, the observed association between mothers' learning and their children's KS3 scores became statistically insignificant.

However, this negative result could be partly attributable to the coarseness of our measure of adult learning, since it combined different forms of learning engaged by mothers and compared them with mothers who were not engaged in learning at all. For this reason, we undertook a more refined classification of adult learning by differentiating between:

- the types of courses on which mothers were engaged – whether or not they led to qualifications or were formally taught courses;
- the time that mothers spent in learning and the intensity of the learning experience;

- mothers' prior educational qualifications.

For all but one of the subgroups generated by these more refined classifications, the initial associations between mothers' duration and engagement in learning and their children's KS3 performance became statistically insignificant once we introduced controls for mothers' prior educational attainment and other characteristics. And for the one exception – mothers who undertook a combination of informal learning and learning not leading to qualifications – the association with their children's later attainment was significant only at the 10% level.

Taken together, the findings presented here suggest that there are limited additional benefits of adult learning on their children's KS3 results, particularly once mothers' previous educational qualifications are taken into account.

On the face of it, this might suggest that it is mothers' initial schooling, rather than their adult learning, which is important for children's academic achievement. Indeed, the importance of parents' initial schooling is strongly supported by other research. However, the result of our study does not necessarily mean that parents' adult learning is not important for children's schooling, as there are a number of important limitations to our approach in terms of scope and data.

With regard to scope, we focused in this study on the adult learning of mothers, and on the effects on their children's academic attainment at KS3 (age 14). There are thus important aspects of the relationship between parents' adult learning and their children's achievement that we have not investigated – namely the effect of fathers' adult learning, and the effects of parental adult learning during other stages of their children's cognitive development. We would argue that, given children's increasing independence during adolescence, future research might usefully focus on the role which parents' adult learning has to play in their children's earlier development.

Our study is also limited by the nature of adult learning itself. As discussed by Feinstein and Sabates (2008), adult learning is characterised by a very wide range of providers, modes and types of provision, sources of funding and methods of accountability. This diversity itself makes the establishment of relationships difficult, and in this study we have been able to examine only fairly general indicators of adult learning and their relationship with children's school achievement. It may be that some specific learning interventions – for instance family learning – are very successful at raising children's school achievement. We cannot assume that results from the present study are true of particular learning interventions.

The results of our study therefore, while perhaps in some sense disappointing in that they do not show positive effects of mothers' learning on children's attainment at KS3, do provide us with valuable information and a useful foundation for future research.

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Appendix Description of control variables

Key Stage 2 assessments

Key Stage 2 English

The English assessment is marked out of 100 and consists of three tests: a reading test, a writing test (made up of a longer task and a shorter task), and a spelling test. The spelling test is aggregated with the writing test. In the reading test, questions cover descriptive criteria as well as more open-ended responses. The test includes different texts, such as stories, poems, explanations and interviews. The writing test is designed to assess pupils' individual independent work, and marks are awarded for sentence structure, punctuation and text organisation, and for composition and effect. Marks are also awarded for handwriting.

Key Stage 2 mathematics

The mathematics test is marked out of 100 and consists of three separate tests: a calculator paper, a non-calculator paper and a mental arithmetic test. Most of the questions are worth one mark, although some are worth two and carry one mark for showing appropriate working.

Key Stage 2 science

The science test is made up of two papers. Pupils may be asked to describe how an investigation could be carried out, what factors need to be controlled and measured, whether an outcome can be predicted and how the results could be presented, as well as to explain the outcome and whether the evidence collected is significant, reliable and valid.

Socio-demographic background factors

Mother has a partner at 32 weeks antenatal: This dichotomous variable was coded as: 0 = no partner; 1 = partner.

Mother/partner education: This was based on mother-reported mother and father/partner highest level of educational qualifications coded on a scale from 0 to 4: CSE/lower; less than Level 2 academic and vocational qualifications; O-level/GCSE/Level 2 vocational qualifications; A-levels/Level 3 vocational qualifications; university degree and higher.

Mother/partner social class: The ALSPAC data only contain the derived 1991 OPCS Standard Occupational Classification (Registrar General's Social Class based on Occupation). Family social class is coded as the higher of the mother or

father/partner.⁹ This variable is coded: 1 = I: Professional; 2 = II: Managerial or technical; 3 = III_{nm}: Skilled non-manual; 4 = III_m: Skilled manual; 5 = IV: Partly skilled; 6 = V: Unskilled.

Mothers' employment category: This variable was created by combining mother responses from the 21 months and 33 months questionnaires and is coded: 1 = Employed full-time by 18 months; 2 = Employed part-time by 18 months; 3 = Employed by 18 months, but hours not known; 4 = Employed between 19 and 33 months; 5 = Not employed by 33 months; 6 = Not employed by 21 months.

Household tenure: Household tenure was reported by the mother at 33 months and coded as: 1 = owned/mortgaged; 2 = private rental; 3 = being bought from the council; 4 = rented council; 5 = rented housing association; 6 = other.

Income: Weekly family income was reported by the mother at 33 months and coded as: 1 = less than £100 per week; 2 = £100–£199; 3 = £200–£299; 4 = £300–£399; 5 = greater than £400.

Mother's age at birth of study child: Age of mothers at the birth of the study child ranged from 15 to 44.

Experience of financial difficulties: The financial difficulties score is averaged across mother reports (at 32 weeks antenatal, 8, 21 and 33 months) of experiencing difficulties affording food, clothing, heating, rent or mortgage, things needed for the study child. Zero represents 'no financial difficulties' and 15 represents 'maximum financial difficulties'.

Other information included information about the mother's own childhood home, whether her parents were present during her childhood, their level of education and her father's job status, mother's number of siblings.

Mothers' mental health and attitudes

Mother breastfed: This variable was reported by mothers at 6 months and is coded as: 1 = Not at all; 2 = Less than 1 month; 3 = 1 to less than 3 months; 4 = 3 to less than 6 months; 5 = 6 months and over.

Mother smoked during pregnancy: This variable was measured by mothers at 32 weeks antenatal and reports the number of cigarettes smoked per day during pregnancy. It is coded: 0 = None; 1 = 1–9 per day; 2 = 10–19 per day; 3 = More than 20 per day.

⁹ If mother's class is missing, then it is coded to the father's class, and vice versa. If the mother has 'no partner', then it is coded to the mother's class.

Mother's locus of control score: Locus of control assesses perceived control in individuals' lives. People who believe that an outcome is largely contingent on their own actions are seen as having a more **internal** locus of control. Those who feel that their lives are determined more by luck, fate, chance and other people are considered to have an **external** locus of control. It is measured at 12 weeks antenatal using a shortened version of the ANSIE, the adult version of the Nowicki-Strickland Internal-External locus of control scales (Nowicki and Duke, 1974). The shortened version of the ANSIE comprises 12 of the original 40 items in a yes/no format which assess perceived control (e.g. 'Do you believe that whether or not people like you depends on how you act?' and 'Do you believe that when bad things are going to happen they are just going to happen no matter what you try to do to stop them?'). A high score indicates a more external locus of control.

Mother's social networks score: The social network scale comprises ten items which ascertain the extent of the mother's social networks and is assessed at 12 weeks antenatal. Mothers report on items such as the number of people in their lives they can go to in order to discuss personal problems, get advice on important decisions or borrow money from, as well as the number of times in the last month they have got together with friends and/or relatives. This score ranges from 2 to 14.5, with a higher score indicating more positive social networks.

Mother's own school experiences score: At 12 weeks antenatal, mothers were asked a number of questions about their own experiences at school, such as whether they liked school, thought it was valuable, thought good marks were important or whether it was useless to try, and whether they ever played truant, were suspended or expelled. These items were summed to create a score of school experiences which ranges from 0 to 12, wherein a high score indicates a more negative school experience.

Mothers' mental health and well-being were further assessed using the Crown-Crisp Experiential Index measuring depression, anxiety and somatic symptoms (Crown and Crisp, 1979) and the Edinburgh Postnatal Depression Scale (Cox, Holden and Sagovsky, 1987). Mothers' self-esteem was measured using the Bachman Self-Esteem Scale (Bachman and O'Malley, 1977).

Parent-child relationships and the home learning environment

Mother-child interaction score: Mother-child interactions were measured using the summed responses to questions about how frequently they sing and read to/with their children, and play with them, etc. The mother-child interaction score reports the average of these scores measured at 6, 18, 30 and 42 months. A higher score indicates more frequent interactions.

Number of books/number of toys in the home score: Mother-reported number of books and toys in the home (none, 1-2, 3-9, 10 or more) was measured at 6, 18, 30 and 42 months and averaged to create a continuous score.

Teaching activities score: At 18, 30 and 42 months, mothers were asked whether they try to teach their child skills and activities such as colours, numbers, nursery rhymes and songs, shapes, sizes, the alphabet, politeness, clapping games, and parts of the body. Responses were summed at each age and averaged to create a continuous score.

Other information included the type and number of hours spent in childcare arrangements at 24 months, and the number of activities parents and children regularly engaged in outside the home at 30 months.

Early child development

Four areas of early development were used to control for emerging IQ and developing skills and capabilities.

Social and personal development assessed 42 months: Items were adapted from the Denver Developmental Screening Test (Frankenburg and Dodds, 1967) and include age-appropriate items such as playing pat-a-cake, helping with household chores, eating with a spoon and fork, washing and drying hands, and dressing. Items were scaled: 0 = not started yet; 1 = only done 1 or 2 times; 2 = yes, often. Responses were summed to give an overall score.

Fine and gross motor development assessed at 6 and 42 months: Again, adapted from the Denver Developmental Screening Test, the fine motor scale includes items such as holding a rattle, ability to focus on and pick up small objects, and using a pencil. Gross motor development covers skills such as kicking and throwing a ball, jumping, and climbing stairs. Items were scaled: 0 = not started yet; 1 = only done 1 or 2 times; 2 = yes, often. Responses were summed to give an overall score.

Temperament assessed at 6 and 42 months: At 6 months, mothers completed the 88-item Carey Infant Temperament scale (Carey and McDevitt, 1977), which assesses how her infant behaves in different situations, such as feeding, playing, being changed, sleeping. The scale yields scores for activity, rhythmicity, approach, adaptability, intensity, mood, persistence, distractibility and threshold. At 42 months, mothers completed the Revised Rutter Parent Scale for Pre-school Children (Elander and Rutter, 1996). This scale is an extension of the Rutter behaviour scale and provides different behaviour scores covering emotional difficulties, conduct difficulties, hyperactive behaviour, prosocial behaviour and other behavioural difficulties.

Physical development assessed at 42 months: Mothers were asked to report any general growth and development worries that they had, such as problems with speech, eyesight, weight, height or behaviour. Items were scaled: 0 = no, not worried; 1 = yes, worried. Responses were summed to give a total score.

Centre for Research on the Wider Benefits of Learning Research Report No.32

The impact of mothers' learning on their children's academic performance at Key Stage 3: evidence from ALSPAC

Ricardo Sabates and Kathryn Duckworth

→ This report investigates whether the inter-generational benefits of parental adult education exist over and above the achievement of educational qualifications during schooling, and whether returns to parental adult learning are greatest for children of parents with low levels of education. Using data from the UK Avon Longitudinal Study of Parents and Children, ALSPAC, results show that mothers' participation in adult education is not associated with improvements in their children's academic attainment in English and maths at age 14. This lack of relationship held for the overall sample, and for subgroups defined by the type of adult education (accredited, unaccredited or informal learning), the intensity of learning (duration and engagement) and by mothers' prior educational qualifications.

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