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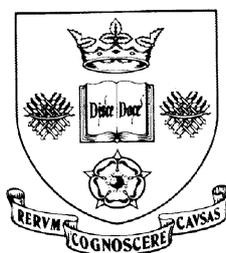


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**Persistent Poverty and Children's Cognitive Development: Evidence  
from the UK Millennium Cohort Study**

**November 2011**

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**PERSISTENT POVERTY AND CHILDREN'S COGNITIVE DEVELOPMENT:  
EVIDENCE FROM THE UK MILLENNIUM COHORT STUDY**

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November 2011

**Abstract**

We use data from the four sweeps of the UK Millennium Cohort Study (MCS) of children born at the turn of the century to document the impact that poverty, and in particular *persistent* poverty, has on their cognitive development in their early years. We show that children born into poverty have significantly lower test scores at age 3, age 5 and age 7, and that continually living in poverty in their early years has a cumulative negative impact on their cognitive development. For children who are persistently in poverty throughout their early years, their cognitive development test scores at age 7 are more than 10 percentile ranks lower than children who have never experienced poverty, even after controlling for a wide range of background characteristics and parenting investment.

**Keywords:** child poverty, cognitive development

**JEL classification codes:** I32, J13, J62

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# PERSISTENT POVERTY AND CHILDREN'S COGNITIVE DEVELOPMENT: EVIDENCE FROM THE UK MILLENNIUM COHORT STUDY

*"Give me a child until he is seven and I will give you the man."*

(attrib.) St. Francis Xavier (1506 – 1552)

## 1. Introduction

In this paper we look at the impact of persistent poverty on the cognitive development of children in the early years of their lives. We use the UK Millennium Cohort Study (MCS) which is a sample of 19,000 children born in UK around the turn of the century. We trace their cognitive development as measured in a series of standard tests up until they are 7 years old. Our focus is on the impact of living in poverty on this cognitive development, and we construct measures of *episodic* (period-by-period) poverty and of *persistent* poverty, in order to examine the cumulative impact of multiple and continuous periods of deprivation on children's cognitive development.

It has become increasingly apparent that there is a strong link between children's development and educational attainment, and their family background (e.g. Blanden et al., 2007; Feinstein, 2003; Gregg and Macmillan, 2009; Heckman and Masterov, 2007). Carneiro and Heckman (2002) use US data to study the relationship between family income and schooling of children. Their findings suggest that it is long-term factors such as better family resources throughout the child's formative years, rather than short-term liquidity constraints, that largely account for the family income gap in college enrolment. Findings by Cameron and Heckman (2001), again based on US data, also demonstrate that it is long-term influences associated with parental background and parental income throughout the child's adolescent years that largely account for the racial-ethnic college enrolment differential. For the UK, using data drawn from the 1970 British Cohort Study (BCS), Feinstein (2003) showed that parental social class or socio-economic status (SES) has an important and long-lasting impact on children's development and attainment. While early cognitive development is a good predictor of educational qualification attainment 20 years later, children from low SES families are particularly disadvantaged. He also argued that children in low SES families are less likely to demonstrate high early scores, and even if they do show signs of good initial cognitive development, this advantage is soon eroded. Any

upward mobility of children with low initial attainment is for children from medium and high SES families<sup>1</sup>.

The link between early educational attainment and SES of families has also been emphasised by policy makers. Coupled with his administration's emphasis on education, in 1999 Tony Blair also famously pledged to end child poverty 'within a generation'<sup>2</sup>. This commitment was accompanied by a range of reforms and initiatives designed to tackle what had become a crisis, with one quarter of all children in Britain living in poverty in 1999<sup>3</sup>. The following decade saw significant reductions in the child poverty rate measured in both relative and absolute income terms (Waldfoegel, 2010). However, the rate of progress slowed somewhat after 2003/04, and progress towards the intermediate target of cutting the child poverty rate in half by 2010 was missed. Consequently, the prospect of 'eliminating' child poverty by 2020 looks increasingly difficult. However, in March 2010, the Child Poverty Act enshrined in law the commitment to end child poverty by 2020. Explicit targets have been set in terms of relative income, material deprivation and absolute income measures. In addition, and as a late addition to the legislation, the significance of 'persistent poverty' was recognised, with a target to be set in regulations by 2014.

Most recently, the Field Review (Field, 2010) on 'Poverty and Life Chances' called into question the focus on income poverty. Instead, the review recommended greater attention be paid to the problem of the intergenerational transfer of poverty.<sup>4</sup> The role of family background, the quality of parenting, and children's opportunities for learning and development were argued to be crucially significant in determining children's adult outcomes because of their importance in children's development before age 5 ('Foundation Years' in the terminology of the review). Consequently, the review argued that supporting parents and their children in these early years through directed government spending should be the priority. Thus, rather than making income transfers to poorer families through the tax credit system, the Field review recommends that consideration should always be given to whether that income would be more effectively spent in improving early years provision of services such as Sure Start in order to improve the outcomes that children from poor families might achieve in their adult lives. Such recommendations represent a clear change in focus.

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<sup>1</sup> There has been some recent reassessment of the latter finding (Jerrim and Vignoles, 2011) which we address in section 2 below.

<sup>2</sup> "Our historic aim will be for ours to be the first generation to end child poverty", Tony Blair, Beveridge Lecture, 1999.

<sup>3</sup> This was the proportion living in poverty measured before housing costs (BHC); the after-housing-costs (AHC) measure was greater than one third.

<sup>4</sup> The Field review is entitled: *The Foundation Years: preventing poor children becoming poor adults* to reflect this intergenerational focus.

In this paper we examine the relative importance of both family background (including parenting and opportunities for learning and development) and income poverty – especially the persistence of poverty – for children’s early cognitive development. As far as we are aware, this is the first paper to systematically examine the impact of persistent poverty on children’s cognitive development in contemporary Britain. We show that children born into poverty have significantly lower test scores at age 3, age 5 and age 7, and that continually living in poverty in their early years has a cumulative negative impact on their cognitive development. This result is robust to the ‘quality’ of parenting and family background etc. It therefore suggests that income poverty remains important for development, and cannot be mitigated completely by the better provision of parenting support services.

The remainder of this paper is organised as follows. In the next section, we briefly review the relevant literature on cognitive development, family background and poverty. Section 3 describes the data and the tests that are used to measure children’s cognitive development, together with the methodology we employ to measure persistent poverty and to link child poverty with cognitive development. Section 4 presents our main results, and section 5 draws some conclusions and implications.

## **2. Background literature**

Feinstein (2003) examined the impact of parents’ socio-economic status (SES) on the cognitive development of children in the BCS70 (i.e. born in 1970). The BCS70 children were assessed at 22 months, 42 months, 5 years and 10 years (and subsequently followed up at age 26). Feinstein is able to exploit information on test scores for 1,292 children in his analysis<sup>5</sup>. Pre-school educational inequality is both persistent and pervasive, and is heavily influenced by family background. He showed that the children of high SES parents who scored poorly in the early tests had a tendency to catch up, and indeed surpass, the cognitive attainment of children who did well in the early tests but were born to low SES parents. In contrast, the children of low SES parents who scored poorly in the initial tests were unlikely to ever to overcome these initial disadvantages. One criticism of his research is that it may be reflecting, at least partially, ‘regression to the mean’. But even in their careful reassessment of Feinstein’s work, Jerrim and Vignoles (2011) clearly corroborate his central

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<sup>5</sup> While the full BCS70 contains around 17,000 children, only a sub-sample of around 2,400 were tested at 22 and 42 months, and then only about half of these were followed successfully up to age 10.

finding that children from more advantaged backgrounds have much better cognitive skills development.

Our paper has a number of parallels with Feinstein's study in that we are also interested in the impact of family background on children's early cognitive development, although our focus is on poverty and the persistence of poverty rather than differences over time by social status. Moreover, we have the advantage that we have considerably more children in the MCS, and hence can potentially examine different sub-groups within the population<sup>6</sup>. Furthermore, unlike the BCS70, our sample also includes children in one parent families. This is important for our analysis of the impact of poverty on cognitive development, since we know that children of one parent families are considerably more likely to be in poverty than those in two parent families (see, for example, HBAI, 2010). And, finally, of course, the BCS70 children were born more than 40 years ago.

Gregg and Macmillan (2009) examine the impact of parental income on children's education and test scores using various UK cohort studies: National Child Development Study (NCDS, born in 1958); BCS70; three separate cohorts constructed from the British Household Panel Survey (BHPS, for children born in the late 1970s, early 1980s, and late 1980s); Avon Longitudinal Study of Parents and Children (ALSPAC - a Bristol-based birth cohort of children born in 1991/92); and the Longitudinal Study of Young People in England (LSYPE, a national sample of children born in England in 1989/90). They consistently find that children born into poorer families have a lifelong disadvantage. However, the youngest children for which they have test score information are aged 7.

Goodman and Gregg (2010) utilise the second and the third sweeps of the MCS. The focus of their work is on explaining the rich-poor gap in the cognitive ability of children by analysing the influence of aspirations and behaviour of parents on the educational outcomes of their children. However, they do not take into account the persistence of poverty in documenting or explaining the existence of the gap in ability. Blanden and Machin (2010) also utilise the second and the third sweeps of the MCS. The focus of their work is on examining the connection between parental income and child's vocabulary and behaviour. Consistent with the previous literature, their findings also suggest that better child outcomes (vocabulary development and behaviour) are associated with wealthier parents. For example, children from families in the top quintile in terms of income are more than one year ahead in vocabulary development at age 5 as compared to children from the bottom quintile. For the

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<sup>6</sup> MCS oversamples ethnic minorities and disadvantaged households and thus provides sufficient observations to separately identify and control for differences between these groups.

US, Cunha and Heckman (2007) find similar gaps in vocabulary and maths development of children by the age of 5 when making comparisons across quartiles of parents 'permanent income'.

None of the studies cited above examine the impact of persistent poverty. In contrast, Schoon et al. (2010) use the MCS data to look at the impact of persistent financial hardship (measured as the family being in receipt of state benefits) on the cognitive and behavioural development of children at age 5. Their findings suggest that persistent financial hardship has a large and negative impact on children's cognitive development, while the impact on children's behavioural adjustment is rather less. Further, this negative impact is mitigated by the 'protective factors in the family environment'. Our paper is different from Schoon et al. (2010) in number of important aspects. First, we consider a longer time horizon by examining children's development at age 3, age 5 and age 7 – most importantly, thus including a period when they have been attending school. Second, we explicitly model the parental investment in children, what Schoon et al. (2010) refer to as the 'protective factors'. Finally, we utilise more robust measures of 'persistent poverty'.

Barnes et al. (2010) also examine the impact of persistent poverty (defined as being in poverty for at least 3 of the 4 annual interviews of the *Growing up in Scotland* study) on young children in Scotland. They note that poverty is multi-dimensional and that many, if not most, of its effects can be captured through correlated characteristics such as low parental education, poor health etc. Indeed, low income is not statistically significantly correlated with child outcomes (such as being overweight, poor language, social and emotional development etc) once all of these other family and various area factors are taken into account. Of course, this does not mean that income is not important for child outcomes, but rather that its impact is indirect, through its effect on other factors which are correlated with outcomes. In our analysis, we are able to capture and distinguish between both the direct and the indirect impact of income poverty.

Our brief review of the literature suggests that the impact of the persistence of poverty remains a largely unexplored aspect of the importance of family background and other characteristics on children's cognitive development and educational attainment. Our paper is a contribution towards an investigation of this important issue.

### **3. Data and measurement**

The UK Millennium Cohort Study (MCS) is following a large sample of around 19,000 babies born in 2000-01. The first sweep (MCS1) took place in 2001-02 when these babies were, on average, around 9 months old, and recorded details of their family background, parents, mothers' pregnancy and birth, and the early months of their lives. The second sweep (MCS2) took place when the children were around 3 years old, while the third sweep (MCS3) was administered when the children had reached age 5 and had started school. Finally, the fourth sweep (MCS4) was undertaken in 2008 when the children were 7 years old on average<sup>7</sup>. Information is gathered in face-to-face interviews on a wide range of socio-economic and demographic characteristics about the child, their family (parents and grandparents), parenting activities, cognitive assessment, and, latterly, early education. The survey has a clustered stratified design (oversampling ethnic minorities, and areas with high child poverty for example) and hence appropriate statistical techniques and sampling weights need to be employed in order to generate statistics which are relevant to the population as a whole. We use all of the first four sweeps of the MCS.<sup>8</sup>

#### **3.1 Measuring child poverty**

##### *Poverty incidence*

We compute three different measures of the incidence of child poverty. Poverty rate (1) is the poverty measure taken directly from the MCS. This is set at a level of equivalised household income less than 60% of the median household income, where income is equivalised according to the OECD equivalence scale. Poverty rate (2) has been calculated from the banded income information recorded in the MCS. First, households are assigned an income equal to the mid-point of the income band that they select at each sweep.<sup>9</sup> This is then equivalised using information on their household composition to derive an OECD equivalence scale measure. A household is then designated to be in poverty if their equivalised income is less than 60% of the contemporary median household income threshold derived from the relevant HBAI/FRS (source: Joyce et al, 2010). Poverty rate (3) has been calculated similarly to poverty rate (2), with the exception that the poverty line used is 60% of the median of the equivalised income of the households in the MCS i.e. measured relative to families within the MCS cohort (and thus families with at least one young child) rather than for all households as in the HBAI/FRS.

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<sup>7</sup> The fifth sweep is scheduled to take place in 2012 when the children will be 11 and in their final year of primary school.

<sup>8</sup> Weights which take account of differential sampling, non-response and attrition have been used throughout the analysis – see Hansen (2010) for details.

<sup>9</sup> There are up to 18 income bands in the first three sweeps of the MCS and 19 bands in MCS4 (the income bands are different for single parent families and for couples). Given the large number of income bands, using the midpoints does not seem to be overly restrictive.

### *Persistent poverty*

There are three papers which propose alternative measures of persistent poverty: Foster (2009), Bossert et al. (2008) and Dutta et al. (2011). All three propose variants on a similar basic metric. The persistent poverty measure at time  $T$ ,  $PPM_T$ , can be expressed as:

$$PPM_T = \frac{1}{T} \sum_{t=1}^T \omega_t P_t \quad (1)$$

i.e. as a weighted average of all past poverty episodes, where  $P_t$  is the poverty indicator for time period  $t$  defined as:

$$P_t = \begin{cases} 1 & \text{if } y_t < z_t \\ 0 & \text{if } y_t \geq z_t \end{cases} \quad (2)$$

$y_t$  is income,  $z_t$  is the poverty line/threshold and  $\omega_t$  is the weight given to being in poverty at time  $t$ . The three papers only differ in the assumptions they make about  $\omega_t$ .

Foster (2009) sets  $\omega_t = 1 \forall t = 1, \dots, T$ , and thus his measure of persistent poverty is simply the proportion of periods that an individual has been in poverty over the time horizon  $T$ , irrespective of the timing of those episodes of poverty. Bossert et al. (2008) set  $\omega_t = m_t$ , where  $m_t$  is the number of consecutive episodes of being in poverty, including period  $t$ . This measure allows for the 'bunching' effect of poverty i.e. if poverty states occur together, then they may have a bigger impact than if the poverty states are interrupted by periods of relative affluence. Finally, Dutta et al. (2011) set  $\omega_t = (1 + n_t)^{-\beta}$ , where  $n_t$  is the number of consecutive non-poor episodes (i.e. periods of (relative) affluence) prior to period  $t$ ; and  $\beta \geq 0$  is a parameter of choice, which depends on how much the planner/researcher wants to discount the impact of episodes in poverty. This measure allows for the bunching effect of periods of affluence i.e. it allows the periods of affluence to mitigate the effect of poverty. If an individual has had a longer spell of affluence before a given poverty state then s/he is less impacted by being in poverty relative to the person with a shorter prior spell of affluence.

In this paper, we choose a weighted average of the Bossert et al. (2008) and the Dutta et al. (2011) persistent poverty measures. We define the weights,  $\omega_t$ , as:

$$\omega_t = \alpha m_t + (1 - \alpha)(1 + n_t)^{-\beta} \quad (3)$$

This allows us to combine the separate impacts of the bunching effect of multiple spells of poverty and also of the periods of affluence. For longer time horizons ( $T$ ), when the number

of different potential poverty profiles increases<sup>10</sup>, the weights we propose are able to differentiate more finely between the larger numbers of profiles. Specifically, in the empirical application we set  $\alpha = 0.5$  and  $\beta = 1$ .<sup>11</sup> We also remove the  $T^{-1}$  averaging to ensure that our persistent poverty metric retains ‘time monotonicity’ as a property (Mendola et al., 2011).

### 3.2 Cognitive test scores

The MCS records a number of standard tests of cognitive development. In each case, these are age-appropriate tests administered to the children themselves. We focus on the children’s performance across all of these tests since they each reflect different cognitive abilities and educational concepts and performance. There are two tests in MCS2 (age 3), and three in each of MCS3 (age 5) and MCS4 (age 7). These tests are described briefly below.<sup>12</sup>

The British Ability Scales (BAS) are a set of standard age-appropriate individually-administered tests of cognitive abilities and educational achievements suitable for use with young children – see Elliott et al. (1996, 1997) for further information. Six different BAS tests have been administered across the MCS sweeps. The BAS Naming Vocabulary test (BAS-NV) is a verbal scale which assesses spoken vocabulary. The children are shown a series of coloured pictures of objects one at a time which they are asked to name. The scale measures the children’s expressive language ability. The raw scores are then adjusted using a set of standard adjustment tables to take account of the age of the child and the difficulty of the item set administered. This test was administered in MCS2 and MCS3. In the BAS Pattern Construction test (BAS-PC), the child constructs a design by putting together flat squares or solid cubes with black and yellow patterns on each side. The child’s score is based on both speed and accuracy in the task. Once again, the raw scores are adjusted for age and the difficulty of the test with reference to a set of standard tables. This test was administered in MCS3 and again in MCS4. The BAS Picture Similarity test (BAS-PS) was administered in MCS3. This test assesses pictorial reasoning. Finally, in the BAS Word Reading test (BAS-WR), the child reads aloud a series of words presented on a card. This was administered in MCS4 (age 7).

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<sup>10</sup> The number of different potential poverty profiles is  $2^T$ .

<sup>11</sup> We also tested the sensitivity of our findings to different choices for the weights  $\omega_t$ . In particular, we considered both extremes of  $\alpha = 1$  (the Bossert et al., 2008, measure) and  $\alpha = 0$  (the Dutta et al., 2011, measure). The results are qualitatively similar to those presented here and are available on request.

<sup>12</sup> This subsection follows Hansen et al (2010).

In addition to the six BAS-based tests, two further tests were administered. First, the Bracken School Readiness Assessment (BSRA) is used to assess the conceptual development of young children across a wide range of categories, each in separate subtests – see Bracken (2002). MCS2 employs six of the subtests which specifically evaluate: colours; letters; numbers/counting; sizes; comparisons; and shapes. The BSRA test result used is a composite score based on the total number of correct answers across all six subtests. Second, in MCS4, children’s numerical and analytical skills are assessed using a variant of the National Foundation for Educational Research (NFER) standard Progress in Maths (PiM) test in which a range of tasks covering number, shape, space, measures and data are assessed.

For each of the tests, we use the age-standardised versions<sup>13</sup> where appropriate, and construct the child’s percentile ranking across all children in the MCS who complete the test to take account of differences in scale and dispersion between the tests. The percentile rankings record on a scale of 0 to 100 the percentage of children in the sample completing the test who are ranked at or above the child’s score. Thus a child’s ranking of 90 on a particular test indicates that 90 percent of children scored lower in the test; the child is thus in the top 10% of the specific test score distribution. Percentile rankings also provide a convenient and informative metric against which to record the influence of poverty on the different cognitive skills assessed in each of the tests.

### **3.3 Independent variables**

There is considerable evidence in the literature that children’s cognitive test scores are influenced by the background characteristics of the child, parental investment and parenting style (Field, 2010; Ermisch, 2008; Kiernan and Huerta, 2008; Kiernan and Mensah, 2011; Schoon et al., 2010). Thus, the independent variables that we consider capture a range of family and other background characteristics which impact on children’s cognitive development. These additional variables can be divided into three categories: background characteristics; parental investment; and parenting style. The respondent is the main carer of the child, which in the majority of cases is the mother.<sup>14</sup>

#### *Background characteristics:*

The background characteristics include: the child’s age; birth weight; ethnicity (6 categories); mother’s education (6 categories); mother’s work status (=1 if working); housing tenure (=1 if

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<sup>13</sup> Age is measured in months given the rate of cognitive development in the early years.

<sup>14</sup> Identical questions are not asked in every sweep of the MCS since the focus is on making the survey age-relevant. Descriptive statistics for each of the independent variables are available on request.

renting from local authority or Housing Association); and the Kessler (K6) psychological distress scale. The Kessler et al. (2002 and 2010) scale is a measure of psychological distress and ranges from 0 to 24, with a score of 12 or more considered as 'high risk'.

*Parental investment:*

These variables capture the parental investment in the active learning of the child. They include: how often the child is read to (5 categories from 'never' to 'every day'); how often the child paints or draws at home (5 categories); how often the child is helped with reading (5 categories); how often the child is helped with writing (5 categories); how often the child visits the library (3 categories); and how often the child is helped with maths (5 categories). In addition, fathers are also asked how often they read to their child (5 categories).

*Parenting style:*

These variables record the different ways that parents regulate their child's behaviour and their relationship with the child. They include: whether the child has a regular bedtime; how much TV the child watches; whether the parents smack, or shout at the child if they are being naughty (3 categories). Finally, in sweep 2, the Pianta parenting scale (Pianta, 1995) is used to capture the mother-child relationship. This has 7 positive (PPS) items (such as 'I share an affectionate, warm relationship with the child') and 8 negative (NPS) parenting items (such as 'the child is sneaky or manipulative with me'). For each item, the mother responds on a five point scale from 'definitely does not apply' to 'definitely applies'.

### **3.4 Estimation Methodology**

We employ two different empirical methodologies to understand the link between poverty and cognitive development. Within each approach, we examine two different specifications. In the first specification, we correlate the children's test scores with our measures of poverty using only age as a control variable (since there is evidence that the performance on the tests differs significantly by the age of the child, despite the test scores being normalised for age). In the second specification, we include the additional independent variables as described in the previous sub-section since these have been found in the literature to have an important influence on children's cognitive development (e.g. Cunha and Heckman, 2008).

*Seemingly Unrelated Regressions Estimator (SURE)*

For the first methodological approach, the measures of cognitive ability as reflected in the individual test scores are regressed on the indicators capturing the incidence of poverty, past and present. We estimate the resulting models by SURE (Zellner, 1962) so that unobserved

influences on test scores are allowed to be correlated across tests. More specifically, we estimate a system of equations for the cognitive test rankings as follows:

$$Y = \alpha + \beta_1 X + \beta_2 PI + \epsilon \quad (4)$$

where  $Y' = \{\text{BSRA}(3), \text{BAS-NV}(3), \text{BAS-PS}(5), \text{BAS-PC}(5), \text{BAS-NV}(5), \text{BAS-WR}(7), \text{BAS-PC}(7), \text{PiM}(7)\}$ , is an  $(8 \times 1)$  vector of the different test scores, across the ages 3, 5 and 7 (as indicated in parentheses);  $X$  is a matrix of the (sweep-specific) background characteristics including the poverty measures;  $PI$  is a matrix of parental investment and parenting style indicators;  $\alpha$ ,  $\beta_1$ , and  $\beta_2$  are parameter vectors to be estimated; and  $\epsilon$  is the  $(8 \times 1)$  vector of error terms, assumed to be uncorrelated across observations but correlated across equations.

We estimate a SURE model to allow our results to be interpreted in the context of the previous UK literature (Feinstein, 2003; Gregg and Macmillan, 2009; Goodman and Gregg, 2010; and Blanden and Machin, 2010). However the SURE model and other reduced-form regression-based approaches have been criticised (Cunha and Heckman, 2008; Jerrim and Vignoles, 2011). The problem is that while we want to explore the cognitive ability of the child, what we observe are the test scores which are correlated with the latent cognitive ability but measure it with error. This leads to standard problems econometrically and in interpretation. Cunha and Heckman (2008) discuss the issue in terms of ‘measurement error’ while Jerrim and Vignoles (2011) focus on the implication in terms of ‘regression to the mean’. The basic argument is that the imperfection/randomness in testing means that classifying children as high or low ability on the basis of a single test (and one administered when they are young and therefore when testing is likely to be less than perfect) is liable to be subject to error since getting a relatively high (low) score on a given day is likely to be followed by a less extreme score (i.e. will be lower (higher)) if they were tested on another day. This is the basis of ‘measurement error’ and ‘regression to the mean’.

#### *Structural Equation Modelling (SEM)*

Thus, while we present the results from the SURE model, we also use a second methodological approach - Structural Equation Modelling (SEM). Here we explicitly treat the test scores as imperfect measures of the latent cognitive ability of the child and use the multiple tests at each age to estimate the latent cognitive ability of the child. While the tests might be individually imperfect, they are correlated with the same underlying latent ability, and these multiple measure of the latent cognitive ability serve to mitigate the measurement error problem. The SEM has two components – a structural model and a measurement model. Following Cunha and Heckman (2008), let  $\theta = (\theta_3, \theta_5, \theta_7)'$  be the vector of latent

cognitive skills of the child at age 3, 5 and 7 years;  $\lambda = (\lambda_3, \lambda_5, \lambda_7)'$  be the vector of latent parental investment in the child at age 3, 5 and 7 years; and  $X$  be a  $(k \times 1)$  matrix of the background characteristics, including the poverty status of the child. The structural model is specified as:

$$\theta = A\theta + B_1X + B_2\lambda + \eta \quad (5)$$

$$\lambda = B_3X + \nu \quad (6)$$

where  $B_1$  is  $(3 \times k)$  parameter matrix associated with  $X$  in equation (5) for the latent cognitive development;  $B_3$  is  $(3 \times k)$  parameter matrix associated with  $X$  in equation (6) for the latent parental investment;

$$A = \begin{pmatrix} 0 & 0 & 0 \\ a_{21} & 0 & 0 \\ 0 & a_{32} & 0 \end{pmatrix}; \quad B_2 = \begin{pmatrix} b_{11} & 0 & 0 \\ 0 & b_{22} & 0 \\ 0 & 0 & b_{33} \end{pmatrix}$$

and  $\eta$  and  $\nu$  are  $(3 \times 1)$  multivariate normal error terms with zero mean and diagonal covariance matrix.

Let  $Y_1$  be an  $(8 \times 1)$  vector with the eight different test scores, across the ages 3, 5 and 7, stacked on top of each other;  $Y_1' = \{\text{BSRA}(3), \text{BAS-NV}(3), \text{BAS-PS}(5), \text{BAS-PC}(5), \text{BAS-NV}(5), \text{BAS-WR}(7), \text{BAS-PC}(7), \text{PiM}(7)\}$ . The measurement model for the latent cognitive skills of the child is then specified as:

$$Y_1 = C_1 + D_1\theta + \varepsilon_1 \quad (7)$$

where  $C_1$  is a  $(8 \times 1)$  vector of intercepts;  $\varepsilon_1$  is a multivariate normal measurement error term, with zero mean and diagonal covariance matrix; and

$$D_1 = \begin{pmatrix} 1 & 0 & 0 \\ d_{21} & 0 & 0 \\ 0 & 1 & 0 \\ 0 & d_{42} & 0 \\ 0 & d_{52} & 0 \\ 0 & 0 & 1 \\ 0 & 0 & d_{73} \\ 0 & 0 & d_{83} \end{pmatrix}$$

A similar measurement equation is written for the latent parental investment:

$$Y_2 = C_2 + D_2\lambda + \varepsilon_2 \quad (8)$$

where  $Y_2$  is a  $(32 \times 1)$  vector with all the measures for the latent parental investment and parenting style, across the ages 3, 5 and 7, stacked on top of each other; and  $C_2$  and  $D_2$  are the corresponding matrices. From equation (5) we obtain:

$$\theta = (I - A)^{-1}(B_1X + B_2\lambda + \eta)$$

where  $I$  is an identity matrix, and hence:

$$E[\theta | X, \lambda] = (I - A)^{-1}(B_1X + B_2E[\lambda | X]) \quad (9)$$

Similarly from equation (6) we obtain:

$$E[\lambda | X] = B_3X \quad (10)$$

Combining equation (9) with equation (7) and equation (10) with equation (8) we obtain:

$$E[Y_1 | X] = C_1 + D_1E[\theta | X, \lambda] = C_1 + D_1(I - A)^{-1}(B_1 + B_2B_3)X$$

$$E[Y_2 | X] = C_2 + D_2E[\lambda | X] = C_2 + D_2B_3X$$

A diagrammatic representation of the estimated structural model is given in Figure 1. Estimation is performed using Mplus v6.1.

There are a number of other important advantages of the SEM approach over and above those mentioned above in dealing with the measurement error in cognitive ability. First, it allows us to utilise more observations. As described in sub-section 3.3, we are using a range of independent variables to capture the impact of background characteristics and parental investment and style. For example, we use 12 independent variables to measure parental investment in any given year. In SURE, if there is no response on any one of these 12 variables, the observation is necessarily dropped from estimation, even if the other 11 questions were answered. For SEM, however, to identify the *latent* parental investment, then as long as the parent has answered at least two of the 12 questions, the observation can still be included in the estimating sample in the SEM approach. Similarly, for identifying the latent cognitive skill - as long as we have scores for the child on at least two of the cognitive tests, the child can be included in the SEM.

A second advantage of the SEM approach is that it allows us to introduce dynamics or persistence in the development of cognitive ability. While the previous measure of latent cognitive ability can reasonably be expected to influence the child's current latent cognitive ability as shown in equation (5), the same cannot be said about the individual specific test scores. By definition, the tests are not repeated as they are age-specific, and thus we cannot include lagged values of tests in the SURE model.<sup>15</sup> However, persistence in cognitive ability can be explicitly incorporated in the SEM approach since it is modelled as a latent variable.

Third, the SEM approach allows us to capture both the direct and the indirect effects of poverty on cognitive development. The direct effects are simply how poverty affects

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<sup>15</sup> For the same reason, it is not valid to treat the data as a panel – we do not have repeated observations on the dependent variable for the same individual.

cognitive development, while the indirect effects capture how poverty affects parental investment and parenting style, which in turn impact upon cognitive development. Equation (5) gives us the direct impact of the exogenous variables (including poverty) on cognitive skills while equation (6) gives us the direct impact of exogenous variables on parental investment. Equations (5) and (6) together give us the indirect effects of the exogenous variables on cognitive skills through their impact on parental investment. Separately identifying the direct and indirect effects allows us to compute the total effect of each of the exogenous variables on cognitive skills development.

## 4. Results

### 4.1 Episodic and persistent poverty

Table 1 reports the episodic incidence of child poverty in the MCS data according to the three measures described in sub-section 3.1. While there is some variation, the correlations between the three measure of poverty incidence are very high – essentially, the same households are designated to be in poverty on all three measures. The subsequent analysis presented below uses Poverty rate (1) throughout, but none of the findings are sensitive to which of the three measures is used.

Table 2 presents the individual poverty profiles, together with our measure of persistent poverty and the proportion of children who experience each poverty profile. The interpretation is as follows. For  $T = 2$ , there are 4 different poverty profiles: PS = 00 indicates no episodes of poverty while PS = 01 indicates not in poverty in first sweep but in poverty in the second sweep etc. Analogously, for  $T = 4$ , there are 16 different poverty profiles, and PS = 1111 denotes being in poverty in all four sweeps. PPM is the persistent poverty measure using weights,  $\omega_t$ , which are a convex combination of the Dutta et al. (2011) and the Bossert et al. (2008) measures of persistent poverty. The key properties of our measure are that not only will a higher number of episodes of poverty increase the measure, but that the earlier the episodes of poverty, the higher is the measure. Compare, for example, for  $T = 4$ , PS = 1100 (row 11) which has a PPM of 2.500 with PS = 0011 (row 9) which has a PPM score of 2.167. Finally, PPP is the prevalence of persistent poverty, calculated using poverty rate (1). As can be seen,  $(100-64=)$  36% of all children have experienced at least one spell of relative poverty by the time they are aged 7. This is higher than the 29% of children who are in poverty at age 7 (table 1).

The correlations between the eight test scores are shown in Table 3. As can be seen, children's performance on each of the tests is positively correlated with their ranking on other tests. Moreover, the tests would appear to capture different dimensions of cognitive development: for example, the highest correlation in the ranking for BAS-PC(7) is the equivalent test taken two years earlier, BAS-PC(5), rather than with any other test administered at age 7.

Figure 2 shows the average test score according to the poverty status of the household at the time the test was taken. As can be clearly seen, the average test scores for the non-poor children are significantly higher than the average scores for the children in poverty across all tests in all years. This finding is consistent with the previous literature in this area. Figure 3 shows the average scores for the two extreme poverty profiles: children who have never been in poverty and those that have always been in poverty at each sweep. The differences are larger here than in Figure 2 and this is *prima facie* evidence to suggest that there may be cumulative effects from poverty persistence on cognitive test score outcomes.

There may be a number of possible explanations for the differences observed in the raw data. For example, even though the test scores are age-adjusted within 3 month bands, children's cognitive development is extremely rapid in the early years, and the tests are not administered to all children at exactly the same age. Hence the age of the child when tested can impact significantly on the test score outcome. Also, as suggested by the previous literature and the Field (2010) review, the background characteristics of the child, parental investment and parenting style may also influence the test scores.

#### **4.2 Child poverty and cognitive development**

The results from the SURE estimation approach are presented in Tables 4 and 5 for episodic and persistent poverty respectively. In each table, Panel A includes only the poverty measure (and the child's age) while Panel B includes all of the control variables. Table 4 reveals that the coefficients on all of the episodic poverty dummies – past and present – up until age 5 (MCS sweep 3) are significantly negatively correlated with test score rankings. Thus for children who have any experience of poverty in their early years, their cognitive development test scores will be lower. It is interesting to note that not only does the incidence of poverty matter for their test scores, so too does the timing of the poverty episodes. In general, the most recent and/or current episode of poverty has the least impact. Indeed, by age 7, the impact of contemporaneous poverty (P4) is small and insignificantly different from zero. In contrast, being born into poverty (P1) has the biggest impact on the child's subsequent cognitive development. However, a single episode of poverty, even if it is

preceded and followed by non-poverty states still leaves a significant impact on test scores. The magnitudes of these effects are large. For example, *ceteris paribus*, a child age 3 who has been in poverty since birth can be expected to be  $(10.2+10.8=)$  21 ranks lower on the BAS-NV than a child who has experienced no episodes of poverty.

Panel B of Table 4 presents the results when all of the controls variables are included.<sup>16</sup> Even after controlling for all of the background characteristics, parental investment, and parenting style, a child age 3 who has been in poverty since birth can still be expected to be 10.5 percentile ranks lower on BAS-NV than a child who has experienced no episodes of poverty. The control variables tend to have their anticipated effects. For example, a mother's education has the expected positive impact on the child's cognitive development. A child born to a mother with degree level qualifications or equivalent can be expected to perform around 10 ranks higher (depending on the test) as compared to a child of a mother with no or only few qualifications, consistent with the previous literature in this area. This intergenerational advantage appears at a very early age, and seems to remain high over the early years. The order of magnitude of the advantage for the different tests is variable, however, and is particularly strong in the naming vocabulary tests in the early years.

For the other control variables, mother's employment has a very small positive but insignificant impact on the child's test scores at all ages; maternal depression has negative, though largely insignificant, impact on child's cognitive development; and renting from the local authority or Housing Association is negatively correlated with test performance. 'Positive' parenting activities like reading to the child, taking the child to the library, etc, where significant, have a positive impact on a child's development. Similarly, 'negative' parenting variables such as excessive TV watching, smacking and shouting at the child, where significant, tend to have a negative impact.<sup>17</sup> However, the magnitudes of all of these effects are much smaller than the impact of poverty and mother's education on test scores.

As seen in Table 2, as the number of time periods  $T$  increases, the potential number of different poverty profiles increases. In order to capture and evaluate the impact of the persistence of poverty on children's cognitive development, Table 5 reports the results when we use our persistent poverty measure rather than the episodic poverty incidence dummies. Recall that this measure gives greater weight to earlier episodes of poverty in the overall poverty profile, consistent with the pattern observed in Table 4. As shown in Table 5, the

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<sup>16</sup> The full results are presented in Appendix A, Table A1.

<sup>17</sup> These findings are consistent with those in Kiernan and Huerta (2008) and Kiernan and Mensah (2010). Kiernan and Huerta (2008) use the MCS sweep 2 (age 3), while Kiernan and Mensah (2010) use the MCS sweep 3 (age 5).

coefficient on PPM is significantly negative for all of the cognitive tests at every age. In order to interpret the magnitude of the coefficient on the persistent poverty measure, it is necessary to take into account the possible range of values that the measure can take for each  $T$ . For example, from Panel A of Table 5, consider a child at age 3, who has always been in poverty (PPM = 2.500). On the BAS-NV test, this child will be  $(2.500 \times 7.81 =)$  20 percentile ranks lower than a child who has never been in poverty (PPM = 0.000). Similarly, for a child at age 7 who has always been in poverty (PPM = 7.000), on the BAS-WR test this child will be  $(7.000 \times 2.97 =)$  21 percentile ranks lower than a child who has never been in poverty (PPM = 0.000). Panel B of Table 5 gives a summary of the results from the SURE estimation when all of the control variables are included<sup>18</sup>. The coefficients on the control variables are not very different from those in Panel B of Table 4, and while the magnitude of the effect of persistent poverty is reduced, as expected, it still remains large and statistically significantly negative for test performance.

The results from the alternative SEM approach are reported in Tables 6 and 7 for the episodic and persistent poverty measures respectively.<sup>19,20</sup> The results using both poverty measures are similar. First, there is clear persistence with respect to cognitive ability ( $\theta$ ) – previous latest cognitive ability is positively and significantly correlated with current latent cognitive ability. Thus a child developing well at age 3 is also likely to do well at age 5 and age 7, even after controlling for all other factors. In Table 6, a 1 standard deviation (SD) higher latent cognitive ability at age 3 is associated with a 0.683 SD higher latent cognitive ability at age 5; this is equivalent to an increase of 20 percentile ranks. Similarly a 1 SD higher latent ability at age 5 is associated with a 0.877 SD higher latent ability at age 7; an increase of 26 percentile ranks. The results using the persistence of poverty measure, PPM, in Table 7 are numerically very similar.

Second, Table 6 also reveals that at age 3, latent parental investment ( $\lambda$ ) has a positive and significant impact on a child's latent cognitive ability. If parental investment increases by 1 standard deviation (SD), then the child's cognitive ability would increase by 0.408 SD, equivalent to an increase of 12 percentile ranks. However, this effect is reduced as we move from age 3 to age 5 and, somewhat perversely, appears to be negative at age 7. One possible explanation is that the latent parental investment, which is correlated across time, is

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<sup>18</sup> The full results are presented in Appendix A, Table A2.

<sup>19</sup> The full results with the estimated coefficients for the control variables and the factor loadings for the latent variables are available on request.

<sup>20</sup> Recall that the SEM specification assumes persistence in cognitive development, with past cognitive ability impacting current cognitive ability. There are no tests in MCS1, and thus at age 3, there is no lagged cognitive ability factor.

already embodied in the child's latent cognitive ability at age 5 since this has such a large impact on age 7 cognitive ability. Once again, the results in Table 7 using PPM are numerically very similar.

The significance of the poverty dummies is somewhat reduced in the SEM approach in comparison to the SURE results. In Table 6, only 3 (6) of the 9 estimated coefficients are significantly different from zero at the 5% (10%) level, although 7 are negatively signed. For the poverty dummies in Table 6, a child age 3 who has been in poverty since birth can be expected to be  $(0.177+0.215) = 0.392$  SD below the latent cognitive ability score of the child who has never been in poverty. This is equivalent to 11 percentile ranks, similar in magnitude to the findings from the SURE model with full set of controls. However, in Table 7, the PPM measure is not statistically significant at any age.

As discussed above, one further benefit of the SEM approach is that it allows us to separately identify the direct and the indirect effects of poverty on latent cognitive ability. These are presented in Table 8. The interpretation of the table is as follows. Reading down the first column, the total effect of P1 (poverty at birth) on latent cognitive ability at age 3 is  $-0.252$  SD. The direct effect is  $-0.177$  (the coefficient on the poverty dummy in Table 6). However, there is also an indirect effect through the impact of P1 on latent parental investment in the child,  $\lambda_3$ , which then affects the child's cognitive ability. The total effect of P1 on latent cognitive ability is then the sum of the direct and indirect effects. Similarly, the total effect of P2 (poverty at age 3) on latent cognitive ability at age 3 is  $-0.286$  SD. The direct effect is  $-0.215$  (the coefficient on the poverty dummy in Table 6), while the indirect effect is  $-0.071$ . Combining the effects of P1 and P2, the total (direct+indirect) effect of being always in poverty at age 3 is  $(0.252+0.286=) = 0.538$  SDs, equivalent to 15 percentile ranks.

We can do similar calculations at each age. For example, at age 5, while none of the direct effects of poverty on latent cognitive development are statistically significant, the indirect effects of P1 and P2 are strongly negative. These indirect effects of poverty on cognitive development are manifested through latent parental investment at age 3,  $\lambda_3$ , as well as through poorer cognitive ability at age 3,  $\theta_3$ , which in turn impacts on cognitive development at age 5 through persistence in cognitive ability. The total effect of being in poverty on latent cognitive development at age 5 is again significantly negative  $(-0.244-0.112-0.047=) -0.403$ , although this impact is driven mainly by the indirect effects rather than both the direct and indirect effects as at age 3. Similarly, at age 7, P1, P2 and P3 all have statistically significant negative effects in total, although their direct effects are only weakly significant. Of the total

impact of being in poverty on cognitive development, more than half derives from its indirect effects on parental investment and the persistence in cognitive ability. Finally, it is interesting to note that being in poverty in sweep 4 has no significant direct or indirect impact on latent cognitive ability at age 7. This finding is also consistent with the SURE results presented earlier.

## **5. Conclusions**

This paper documents the impact of episodic poverty and, in particular, persistent poverty, on the cognitive development of children in their early years. Much has been written about the importance of education for future life trajectories. There is also a consensus in the literature that family background, parenting skills and income poverty can all have significant effects on children's early cognitive development. However, this is the first paper to systematically examine and identify the separate impacts of poverty and parenting on children's very early cognitive development.

The key findings of this paper suggest that persistent poverty has a larger cumulative negative impact on children's cognitive development than episodic poverty. For children who are persistently in poverty throughout their early years, their cognitive development test scores at age 7 are more than 10 percentile ranks lower than children who have never experienced poverty. This result is robust to the quality of parenting investment and family background. It is also robust to the methodological approach adopted – SURE or SEM – with the latter providing for a richer interpretation while being more resilient to the weaknesses in the regression-based approach.

Using the SEM approach, we document evidence of strong negative indirect effects of poverty and persistent poverty on children's cognitive development. Poverty adversely affects parental investment, which in turn has a negative impact upon cognitive development. Thus it is not simply that poverty somehow adversely affects children's cognitive development, but rather that low income does not allow for good parenting investment. There is also evidence of strong persistence in cognitive development, so any detrimental impact of poverty on cognitive development has a lasting legacy effect well beyond the episodic incidence of poverty. Poverty at birth and at age 3 can still have an adverse impact on cognitive ability at age 7. Interestingly, poverty at age 7 appears to have neither direct nor indirect effects on cognitive development at age 7. One interpretation is that the importance

of the child's early years' development, coupled with the strong persistence in cognitive ability, dominates the impact of the episodic incidence of poverty at this age.<sup>21</sup>

Those who would argue that the quality of parenting skills and investment are more important for children's development than income may draw some encouragement from the results in this paper. It is clear that parenting investment and parenting style do indeed impact significantly on children's cognitive ability, controlling for income. However, such a conclusion would be to disregard the importance of low income for parenting investment. As shown in this paper, the indirect effect of low income on cognitive development through its impact on parenting investment is very important. Moreover, poverty is seen to still have a direct effect on cognitive development, controlling for parenting investment, especially if the household is in poverty at birth and/or age 3. Together with the strong persistence in cognitive ability, poverty at birth and/or age 3 can therefore seriously impact on children's development by the time they enter school, and thus, as seen in the previous literature, thereafter well into their adult lives. This suggests that policy targeted at poverty alleviation should be directed at these very early years.

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<sup>21</sup> The next sweep of the MCS will allow us to investigate this finding further.

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**Table 1: Poverty incidence**

Sweep	MCS1 2001-2	MCS2 2004-5	MCS3 2006	MCS4 2008
Average age of the child	9 months	3 years	5 years	7 years
Poverty rate (1)	27.9%	28.9%	30.4%	29.1%
<i>Sample size</i>	15,352	13,197	13,802	14,022
Poverty rate (2)	29.2%	32.4%	28.6%	39.3%
HBAI/FRS base year	2001-2	2004-5	2005-6	2007-8
<i>Sample size</i>	17,185	13,306	12,384	13,973
Poverty rate (3)	26.2%	26.2%	23.2%	29.6%
<i>Sample size</i>	17,185	13,306	12,384	13,973

**Notes to Table 1:**

1. Poverty rate (1) is based on the poverty indicators provided by the MCS. The threshold is household equivalised income less than 60% of median household income where income is equivalised according to the OECD equivalence scale. Note that these rates differ very slightly from the rates reported in Hansen et al. (2010, p. 285) which are poverty rates for households not children as here.
2. Poverty rate (2) has been calculated by the authors from the income information recorded in the MCS. This is then equivalised using the OECD equivalence scale computed from their household demographics as recorded in the MCS, and a household is designated to be in poverty if their equivalised income is less than 60% of the contemporary median BHC household income (source: Joyce et al, 2010, based on HBAI/FRS).
3. Poverty rate (3) has been calculated similarly to Poverty rate (2) with the exception that the poverty line used here is 60% of the median of the equivalised income of the MCS sample itself.
4. In all reported statistics, the MCS weights which take into account the survey design, non response bias and attrition over time have been taken into account.

**Table 2: The prevalence of persistent poverty**

Row	Time horizon $T = 2$			Time horizon $T = 3$			Time horizon $T = 4$		
	PS	PPM	PPP	PS	PPM	PPP	PS	PPM	PPP
1	00	0.000	68.6%	000	0.000	65.2%	0000	0.000	64.0%
2	01	0.750	8.3%	001	0.667	5.2%	0001	0.625	2.9%
3	10	1.000	7.3%	010	0.750	4.4%	0010	0.667	3.5%
4	11	2.500	15.9%	100	1.000	4.5%	0100	0.750	3.4%
5				101	1.750	2.4%	1000	1.000	3.8%
6				011	2.250	3.8%	0101	1.500	0.8%
7				110	2.500	3.1%	1001	1.667	0.6%
8				111	4.500	11.4%	1010	1.750	1.1%
9							0011	2.167	1.6%
10							0110	2.250	1.4%
11							1100	2.500	1.8%
12							1011	3.250	1.2%
13							1101	3.250	1.2%
14							0111	4.250	2.2%
15							1110	4.500	2.3%
16							1111	7.000	8.2%
			100.0%			100.0%			100.0%
	Sample size: 11,854			Sample size: 9,897			Sample size: 8,886		

**Notes to Table 2:**

1. PS is the poverty profile or status. The digits describe the poverty status in each sweep, so that, for example, 001 represents individuals who were not in poverty in MCS1 nor in MCS2 but are in poverty in MCS3 – see text for details.
2. PPM is our index or measure of persistent poverty. This measure uses weights which are a convex combination of the Dutta et al. (2011) and the Bossert et al. (2008) measures of persistent poverty – see text for details.
3. PPP is prevalence of persistent poverty (i.e. the proportion of the sample in each poverty state) calculated using the poverty rate (1) measure reported in Table 1.
4. In all reported statistics, the MCS weights which take into account the survey design, non response bias and attrition over time have been taken into account.

**Table 3: Cognitive assessment scores**

	MCS2: age 3		MCS3: age 5			MCS4: age 7		
	1	2	3	4	5	6	7	8
<i>Test</i>	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)	PiM(7)
1 BSRA(3)	1.000 (14,039)							
2 BAS-NV(3)	0.574 (13,753)	1.000 (14,776)						
3 BAS-PS(5)	0.259 (12,381)	0.212 (13,014)	1.000 (15,157)					
4 BAS-NV(5)	0.500 (12,398)	0.515 (13,033)	0.303 (15,130)	1.000 (15,168)				
5 BAS-PC(5)	0.328 (12,360)	0.255 (12,993)	0.330 (15,074)	0.327 (15,103)	1.000 (15,110)			
6 BAS-WR(7)	0.435 (11,204)	0.303 (11,756)	0.227 (12,848)	0.362 (12,861)	0.323 (12,830)	1.000 (13,590)		
7 BAS-PC(7)	0.331 (11,315)	0.260 (11,873)	0.313 (12,958)	0.306 (12,971)	0.554 (12,943)	0.318 (13,483)	1.000 (13,702)	
8 PiM(7)	0.376 (11,359)	0.277 (11,915)	0.313 (13,009)	0.373 (13,022)	0.392 (12,992)	0.499 (13,554)	0.474 (13,651)	1.000 (13,755)

**Notes to Table 3:**

- The tests scores are:  
 BSRA(3) – percentile rank Bracken School Readiness Assessment, age 3  
 BAS-NV(3) – percentile rank BAS naming vocabulary, age 3  
 BAS-PS(5) – percentile rank BAS picture similarity, age 5  
 BAS-NV(5) – percentile rank BAS naming vocabulary, age 5  
 BAS-PC(5) – percentile rank BAS pattern construction, age 5  
 BAS-WR(7) – percentile rank BAS word reading, age 7  
 BAS-PC(7) – percentile rank BAS pattern construction, age 7  
 PiM(7) – percentile rank Progress in Maths, age 7
- Correlations are (weighted) pairwise Pearsonian correlations between the percentile ranking on each test. The number of observations is given in parentheses for each correlation.
- All correlations are statistically significantly different from zero at the  $p = 0.01$  level.
- In all reported statistics, the MCS weights which take into account the survey design, non response bias and attrition over time have been taken into account.

**Table 4: Cognitive development and the incidence of poverty**

<b>PANEL A</b>	MCS2: age 3		MCS3: age 5			MCS4: age 7		
	1	2	3	4	5	6	7	8
	<i>Test</i>	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)
P1	-11.68*** (0.91)	-10.20*** (0.92)	-5.77*** (0.99)	-10.03*** (0.92)	-6.70*** (0.99)	-9.64*** (0.98)	-7.44*** (1.01)	-7.43*** (0.97)
P2	-13.43*** (0.89)	-10.84*** (0.90)	-2.79** (1.02)	-10.05*** (0.94)	-4.98*** (1.01)	-8.19*** (1.01)	-5.99*** (1.04)	-7.08*** (1.01)
P3			-2.04* (0.95)	-1.65* (0.79)	-2.20* (0.93)	-1.96* (0.94)	-2.69** (0.99)	-3.54*** (0.95)
P4						-1.25 (0.92)	0.28 (0.87)	0.34 (0.89)
Controls	No	No	No	No	No	No	No	No
constant	23.67*** (4.52)	36.16*** (4.75)	74.74*** (6.52)	73.53*** (5.47)	146.92*** (6.14)	107.25*** (8.29)	24.55** (8.49)	-70.35*** (8.27)

<b>PANEL B</b>	MCS2: age 3		MCS3: age 5			MCS4: age 7		
	1	2	3	4	5	6	7	8
	<i>Test</i>	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)
P1	-4.84*** (1.40)	-5.46*** (1.47)	-4.61** (1.60)	-3.68* (1.45)	-1.32 (1.58)	-5.20*** (1.50)	-2.98 (1.63)	-3.13* (1.53)
P2	-7.19*** (1.42)	-4.99*** (1.49)	1.02 (1.65)	-5.77*** (1.48)	-3.24* (1.63)	-6.17*** (1.53)	-3.88* (1.67)	-5.06** (1.57)
P3			-2.20 (1.61)	-0.03 (1.35)	-1.26 (1.58)	-3.00* (1.52)	-1.37 (1.67)	-3.83* (1.56)
P4						-2.07 (1.67)	-0.34 (1.64)	-0.32 (1.65)
Controls	Yes <i>Set 2</i>	Yes <i>Set 2</i>	Yes <i>Set 3</i>	Yes <i>Set 3</i>	Yes <i>Set 3</i>	Yes <i>Set 4</i>	Yes <i>Set 4</i>	Yes <i>Set 4</i>
constant	-28.11** (10.34)	-26.46* (11.03)	84.59*** (10.34)	53.59*** (8.79)	125.20*** (9.76)	105.48*** (12.18)	7.67 (12.97)	-91.26*** (12.36)

**Notes to Table 4:**

1. Estimation is by SURE to take into account cross-test correlations in test performance
2. P1, P2, P3 and P4 denote being in poverty in MCS1, MCS2, MCS3 and MCS4 respectively.
3. Standard errors in parentheses; \*\*\* significant at 1%, \*\* significant at 5%, \* significant at 10%.
4. Sample size: *Panel A* 7,681; *Panel B* 3,927.
5. All specifications in *Panel A* and *Panel B* also control for the child's age. The additional controls in *Panel B* are:  
*Set 2*: child's birth weight (in kilos), ethnicity of the child (5 categories: base category is 'white'), mother's work status, mother's education at sweep 2 (5 categories: base category is 'overseas qualifications' and 'none of these), Kessler, Tenure, Read to, Paint, Reading, Library, Counting, Father read, Bed time, TV, Smack, Shout, PPS, NPS.  
*Set 3*: child's birth weight (in kilos); ethnicity of the child (5 categories: base category is 'white'); mother's work status; mother's education at sweep 3 (5 categories: base category is 'overseas qualifications' and 'none of these), Kessler, Tenure, Read to, Paint, Reading, Writing, Library, Counting, Father read, Bedtime, TV, Smack, Shout.  
*Set 4*: child's birth weight (in kilos); ethnicity of the child (5 categories: base category is 'white'); mother's work status; mother's education at sweep 4 (5 categories: base category is 'overseas qualifications' and 'none of these), Kessler, Tenure, Read to, Paint, Reading, Writing, Library, Counting, Father read, Bedtime, TV, Smack, Shout.
6. In all reported statistics, the MCS weights which take into account the survey design, non response bias and attrition over time have been taken into account.

**Table 5: Cognitive development and the persistence of poverty**

<b>PANEL A</b>	MCS2: age 3		MCS3: age 5			MCS4: age 7			
	1	2	3	4	5	6	7	8	
	Test	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)	PiM(7)
PPM		-9.36*** (0.34)	-7.81*** (0.35)	-2.18*** (0.22)	-4.68*** (0.21)	-2.78*** (0.22)	-2.97*** (0.15)	-2.17*** (0.15)	-2.53*** (0.15)
Controls		No	No	No	No	No	No	No	No
constant		24.02*** (4.53)	36.45*** (4.76)	74.80*** (6.53)	73.31*** (5.48)	146.91*** (6.15)	108.43*** (8.32)	25.47** (8.51)	-69.30*** (8.28)

<b>PANEL B</b>	MCS2: age 3		MCS3: age 5			MCS4: age 7			
	1	2	3	4	5	6	7	8	
	Test	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)	PiM(7)
PPM		-4.64*** (0.70)	-3.99*** (0.74)	-1.20* (0.52)	-2.22*** (0.46)	-0.90 (0.50)	-2.47*** (0.34)	-1.05** (0.37)	-1.75*** (0.35)
Controls		Yes set 2	Yes set 2	Yes set 3	Yes set 3	Yes set 3	Yes set 4	Yes set 4	Yes set 4
constant		-28.71** (10.34)	-26.72* (11.03)	84.57*** (10.34)	53.28*** (8.79)	124.56*** (9.76)	105.22*** (12.19)	7.27 (12.98)	-91.74*** (12.38)

**Notes to Table 5:**

1. Estimation is by SURE to take into account any cross-test correlations in performance.
2. PPM is the measure of persistent poverty – see text for details.
3. Standard errors in parentheses; \*\*\* significant at 1%, \*\* significant at 5%, \* significant at 10%.
4. Sample size: *Panel A* 7,681; *Panel B* 3,934.
5. All specifications in *Panel A* and *Panel B* also control for the child's age. The additional controls in *Panel B* are:  
*Set 2:* child's birth weight (in kilos), ethnicity of the child (5 categories: base category is 'white'), mother's work status, mother's education at sweep 2 (5 categories: base category is 'overseas qualifications' and 'none of these), Kessler, Tenure, Read to, Paint, Reading, Library, Counting, Father read, Bed time, TV, Smack, Shout, PPS, NPS.  
*Set 3:* child's birth weight (in kilos); ethnicity of the child (5 categories: base category is 'white'); mother's work status; mother's education at sweep 3 (5 categories: base category is 'overseas qualifications' and 'none of these), Kessler, Tenure, Read to, Paint, Reading, Writing, Library, Counting, Father read, Bedtime, TV, Smack, Shout.  
*Set 4:* child's birth weight (in kilos); ethnicity of the child (5 categories: base category is 'white'); mother's work status; mother's education at sweep 4 (5 categories: base category is 'overseas qualifications' and 'none of these), Kessler, Tenure, Read to, Paint, Reading, Writing, Library, Counting, Father read, Bedtime, TV, Smack, Shout.
6. In all reported statistics, the MCS weights which take into account the survey design, non response bias and attrition over time have been taken into account.

**Table 6: Latent cognitive development and the incidence of poverty**

	Latent cognitive development $\theta$					
	MCS2: age 3		MCS3: age 5		MCS4: age 7	
	$\theta_3$		$\theta_5$		$\theta_7$	
	effect	p-value	effect	p-value	effect	p-value
P1	-0.177	0.001	-0.073	0.103	0.015	0.739
P2	-0.215	0.000	0.086	0.102	-0.101	0.042
P3			-0.046	0.447	-0.093	0.061
P4					-0.036	0.502
$\theta_3$			0.683	0.000		
$\theta_5$					0.877	0.000
$\lambda$	0.408	0.000	0.088	0.000	-0.183	0.000
Controls	Yes		Yes		Yes	

**Notes to Table 6:**

1. All the reported coefficients are standardized. For the continuous independent variables, the coefficient represents the change in the dependent variable associated with a one standard deviation (SD) change in the independent variable. For the binary independent variables the coefficient represents the change associated with a shift in the variable from 0 to 1.
2. Sample size: 7,295.
3. The controls are: child's sweep specific age, child's birth weight (in kilos), ethnicity of the child (6 categories: base category is 'white'), mother's sweep specific work status, mother's sweep specific education (6 categories: base category is 'overseas qualifications' and 'none of these'), sweep specific Kessler score, sweep specific housing tenure.
4. In all reported statistics, the MCS weights which take into account the survey design, non response bias and attrition over time have been taken into account.

**Table 7: Latent cognitive development and the persistence of poverty**

	Latent cognitive development $\theta$					
	MCS2: age 3		MCS3: age 5		MCS4: age 7	
	$\theta_3$ effect	p-value	$\theta_5$ effect	p-value	$\theta_7$ effect	p-value
PPM	-0.065	0.237	-0.058	0.554	-0.003	0.965
$\theta_3$			0.674	0.000		
$\theta_5$					0.890	0.000
$\lambda$	0.415	0.000	0.087	0.000	-0.186	0.000
Controls	Yes		Yes		Yes	

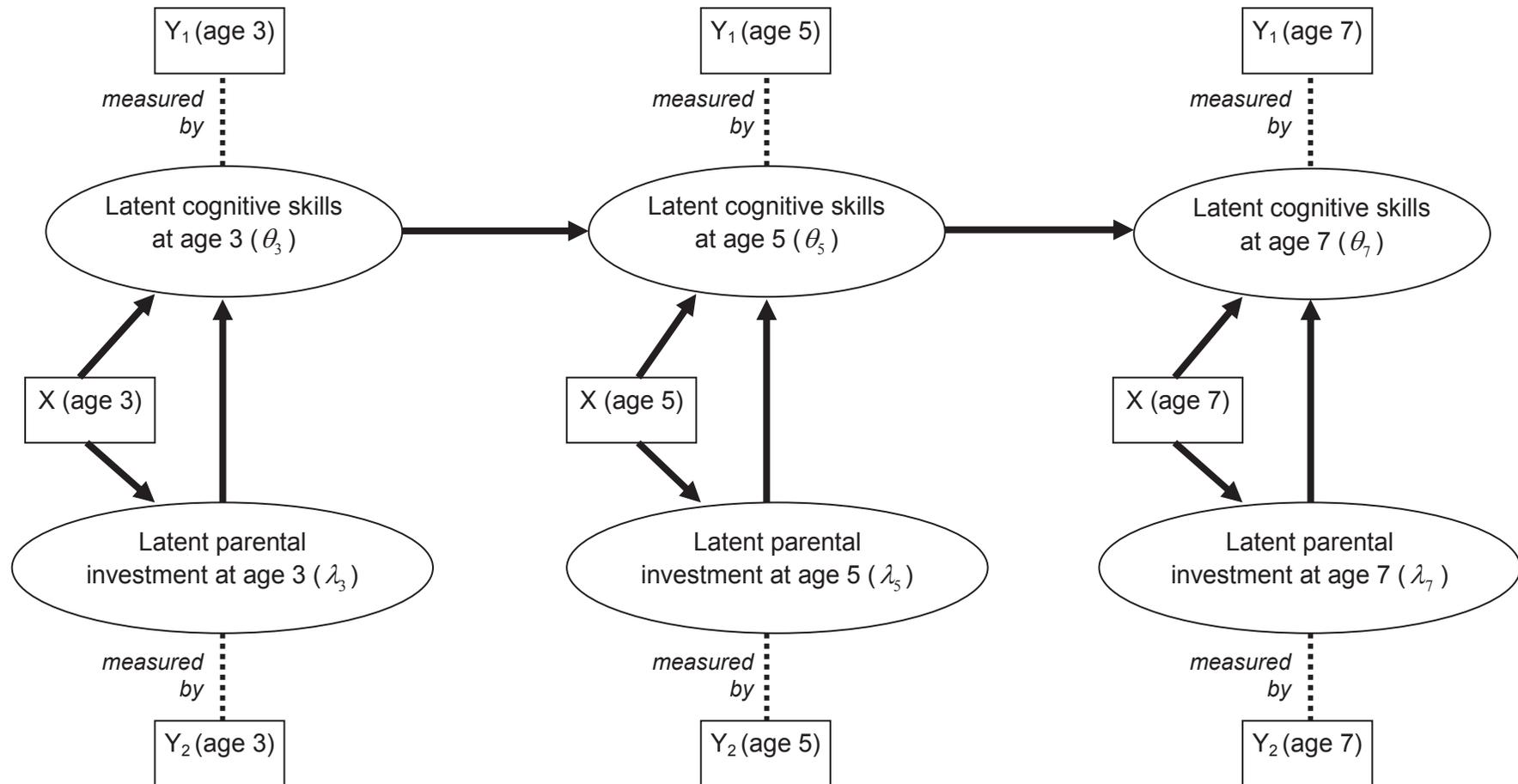
**Notes to Table 7:**

1. All the reported coefficients are standardized. For the continuous independent variables, the coefficient represents the change in the dependent variable associated with a one standard deviation change in the independent variable. For the binary independent variables the coefficient represents the change associated with a shift in the variable from 0 to 1.
2. Sample size: 7,295.
3. The controls are: child's sweep specific age, child's birth weight (in kilos), ethnicity of the child (6 categories: base category is 'white'), mother's sweep specific work status, mother's sweep specific education (6 categories: base category is 'overseas qualifications' and 'none of these'), sweep specific Kessler score, sweep specific housing tenure.
4. In all reported statistics, the MCS weights which take into account the survey design, non response bias and attrition over time have been taken into account.

**Table 8: Identifying direct and indirect effects of poverty on cognitive development**

	Latent cognitive development $\theta$					
	MCS2: age 3		MCS3: age 5		MCS4: age 7	
	$\theta_3$ effect	p-value	$\theta_5$ effect	p-value	$\theta_7$ effect	p-value
<b>Effects from P1:</b>						
Total effect on $\theta$	-0.252	0.000	-0.244	0.000	-0.205	0.000
Direct effect on $\theta$	-0.177	0.001	-0.073	0.103	0.015	0.739
Indirect effect on $\theta$	-0.076	0.000	-0.171	0.000	-0.220	0.000
<i>Indirect via <math>\lambda_3</math></i>	-0.076	0.000	-0.052	0.001	-0.045	0.000
<i>Indirect via <math>\lambda_5</math></i>			0.002	0.691	0.002	0.691
<i>Indirect via <math>\lambda_7</math></i>					-0.006	0.543
<i>Indirect via <math>\theta_3</math></i>			-0.121	0.001	-0.106	0.001
<i>Indirect via <math>\theta_5</math></i>					-0.064	0.104
<b>Effects from P2:</b>						
Total effect on $\theta$	-0.286	0.000	-0.112	0.039	-0.196	0.000
Direct effect on $\theta$	-0.215	0.000	0.086	0.102	-0.101	0.042
Indirect effect on $\theta$	-0.071	0.003	-0.198	0.000	-0.095	0.057
<i>Indirect via <math>\lambda_3</math></i>	-0.071	0.003	-0.048	0.003	-0.043	0.003
<i>Indirect via <math>\lambda_5</math></i>			-0.003	0.527	-0.003	0.525
<i>Indirect via <math>\lambda_7</math></i>					0.004	0.735
<i>Indirect via <math>\theta_3</math></i>			-0.147	0.000	-0.129	0.000
<i>Indirect via <math>\theta_5</math></i>					0.076	0.105
<b>Effects from P3:</b>						
Total effect on $\theta$			-0.047	0.437	-0.121	0.024
Direct effect on $\theta$			-0.046	0.447	-0.093	0.061
Indirect effect on $\theta$			-0.001	0.810	-0.029	0.594
<i>Indirect via <math>\lambda_5</math></i>			-0.001	0.810	-0.001	0.810
<i>Indirect via <math>\lambda_7</math></i>					0.012	0.168
<i>Indirect via <math>\theta_5</math></i>					-0.040	0.448
<b>Effects from P4:</b>						
Total effect on $\theta$					-0.038	0.491
Direct effect on $\theta$					-0.036	0.502
Indirect effect on $\theta$					-0.002	0.843
<i>Indirect via <math>\lambda_7</math></i>					-0.002	0.843

**Figure 1: Structural Model**



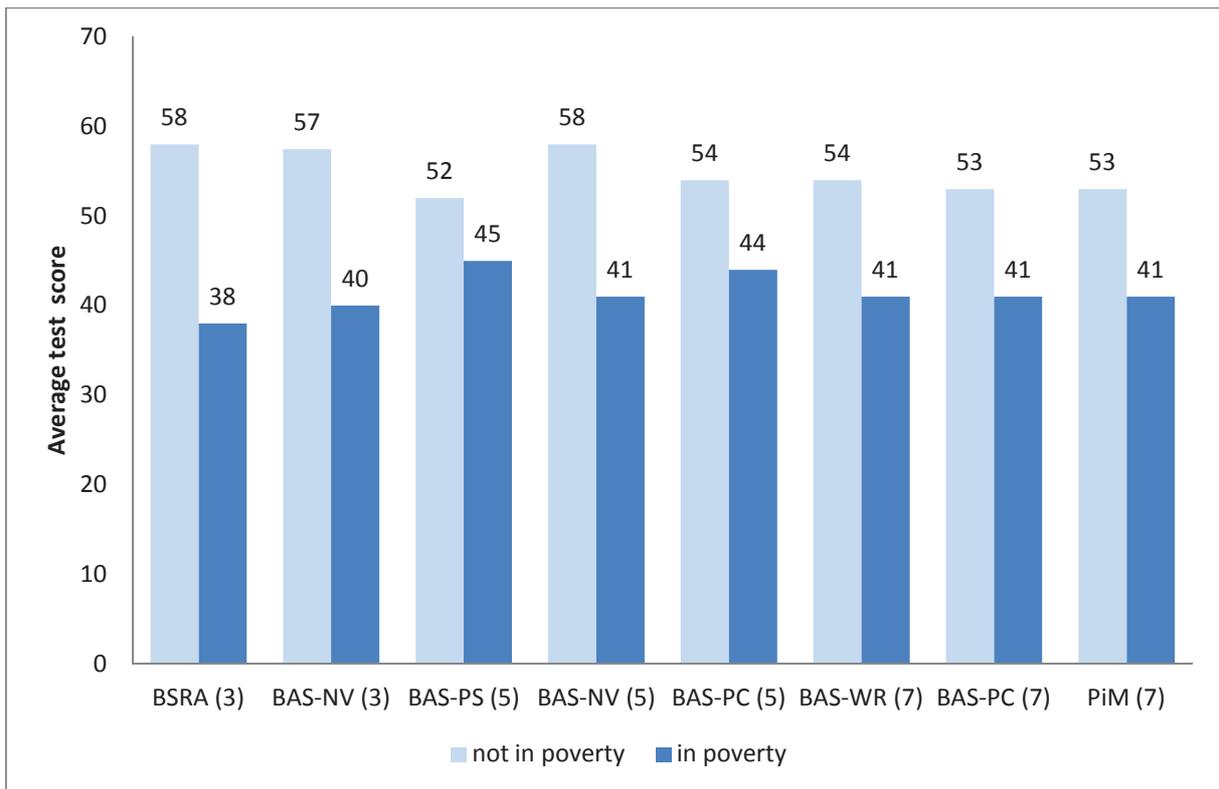
**Key:**

$Y_1$ : Age 3 - BAS-NV(3), BSRA(3); Age 5: BAS-NV(5), BAS-PC(5), BAS-PS(5); Age 7: BAS-WR(7), BAS-PC(7), PiM(7)

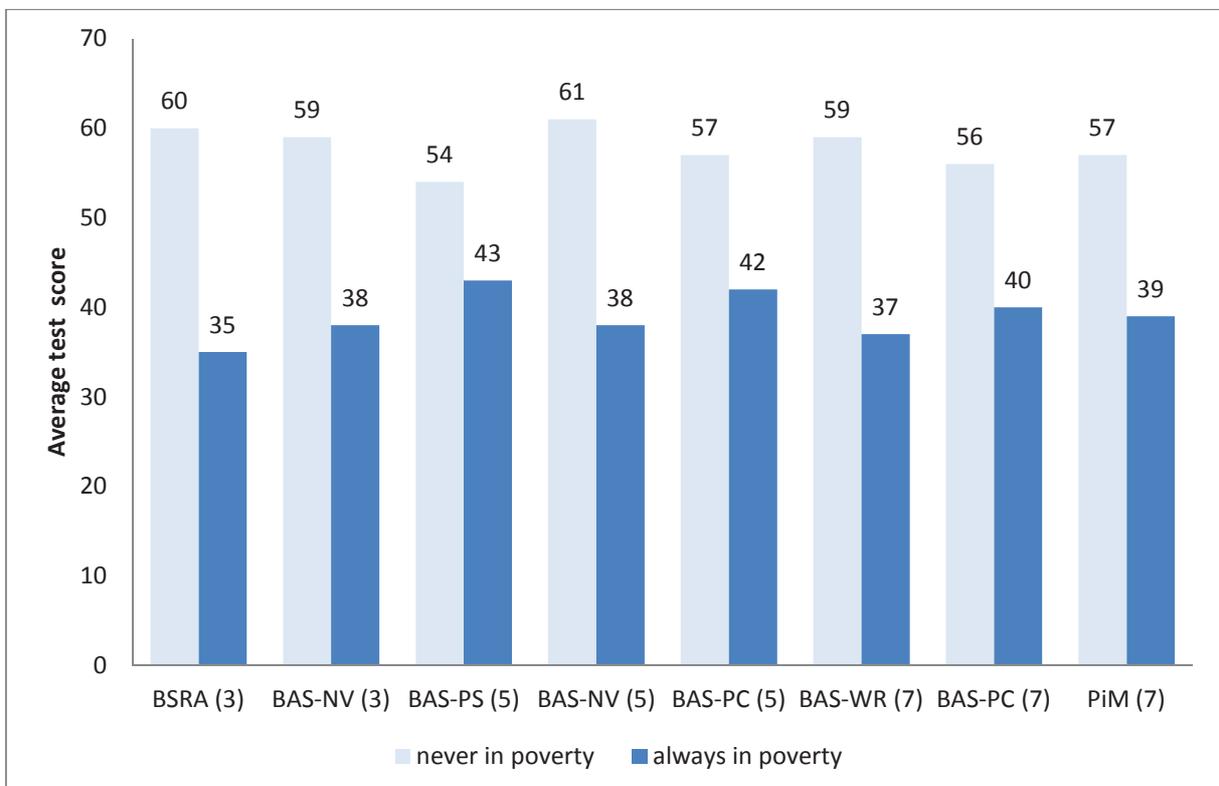
$Y_2$ : Read, Paint, Reading, Writing, Library, Counting, Read-father, Bed time, TV, Smacking, Shouting

$X$ : Age, Birth weight, Ethnicity, Mother's education, Mother's work status, Kessler, Tenure, Poverty Status or Persistent Poverty Measure

**Figure 2: Average test scores by poverty state: period-by-period**



**Figure 3: Average test scores by poverty state: never vs always in poverty**



## Appendix A: Full results

**Table A1: Cognitive development and the incidence of poverty: Table 4, Panel B**

<i>PANEL B</i>	MCS2: age 3		MCS3: age 5			MCS4: age 7		
	1	2	3	4	5	6	7	8
	<i>Test</i>	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)
P1	-4.84*** (1.40)	-5.46*** (1.47)	-4.61** (1.60)	-3.68* (1.45)	-1.32 (1.58)	-5.20*** (1.50)	-2.98 (1.63)	-3.13* (1.53)
P2	-7.19*** (1.42)	-4.99*** (1.49)	1.02 (1.65)	-5.77*** (1.48)	-3.24* (1.63)	-6.17*** (1.53)	-3.88* (1.67)	-5.06** (1.57)
P3			-2.20 (1.61)	-0.03 (1.35)	-1.26 (1.58)	-3.00* (1.52)	-1.37 (1.67)	-3.83* (1.56)
P4						-2.07 (1.67)	-0.34 (1.64)	-0.32 (1.65)
Age	1.02*** (0.18)	0.66*** (0.19)	-0.43** (0.15)	-0.24* (0.12)	-1.28*** (0.14)	-0.59*** (0.13)	0.39** (0.14)	1.57*** (0.13)
Birth weight (in Kilos)	0.40 (0.70)	1.90** (0.73)	-0.01 (0.79)	1.21 (0.72)	3.25*** (0.78)	1.14 (0.73)	3.89*** (0.79)	2.92*** (0.74)
Mixed ethnicity	0.37 (2.70)	1.72 (2.84)	2.90 (3.07)	0.67 (2.79)	3.41 (3.04)	7.22* (2.84)	-1.69 (3.09)	0.96 (2.90)
Indian	-2.85 (4.07)	-14.12*** (4.28)	-2.88 (4.61)	-9.28* (4.19)	-0.79 (4.56)	10.73* (4.27)	-3.03 (4.66)	-1.78 (4.37)
Pakistani and Bangladeshi	-9.62 (5.96)	-28.05*** (6.26)	-6.47 (6.79)	-19.21** (6.16)	2.73 (6.71)	18.00** (6.30)	6.29 (6.86)	-6.75 (6.44)
Black or Black British	-6.92 (5.38)	-20.94*** (5.65)	1.05 (6.10)	-20.21*** (5.54)	0.69 (6.03)	11.13* (5.63)	-16.71** (6.14)	-0.01 (5.76)
Other ethnic Groups	2.56 (6.91)	-32.58*** (7.26)	-11.29 (7.85)	-14.46* (7.13)	0.36 (7.76)	-6.21 (7.27)	-12.71 (7.92)	1.96 (7.43)
Mother works	0.62 (0.78)	0.59 (0.83)	0.25 (0.97)	0.70 (0.83)	-0.81 (0.87)	0.66 (0.93)	-0.30 (0.94)	0.86 (0.93)
NVQ1	0.09 (2.47)	3.00 (2.62)	-0.65 (3.03)	7.96** (2.71)	-3.02 (2.94)	0.69 (2.94)	0.05 (3.17)	-0.85 (3.00)
NVQ2	4.13* (2.00)	6.07** (2.11)	1.32 (2.45)	5.65* (2.19)	4.36 (2.37)	4.63 (2.39)	4.65 (2.57)	3.97 (2.43)
NVQ3	5.25* (2.11)	7.70*** (2.23)	2.72 (2.56)	6.55** (2.29)	3.53 (2.48)	5.03* (2.48)	4.48 (2.67)	5.13* (2.53)
NVQ4	8.92*** (2.02)	9.38*** (2.13)	4.98* (2.46)	14.05*** (2.20)	7.51** (2.38)	9.25*** (2.38)	8.50*** (2.56)	8.48*** (2.43)
NVQ5	12.03*** (2.50)	5.34* (2.65)	7.94** (2.71)	11.54*** (2.41)	5.33* (2.61)	9.57*** (2.63)	9.92*** (2.81)	8.64** (2.67)
Kessler	-0.15 (0.12)	0.02 (0.13)	-0.07 (0.14)	-0.21 (0.12)	-0.11 (0.13)	-0.27* (0.12)	-0.13 (0.13)	-0.08 (0.12)
Tenure	-3.22* (1.31)	-4.66*** (1.39)	-1.22 (1.62)	-3.26* (1.42)	-2.25 (1.54)	-2.73 (1.55)	-2.49 (1.64)	-3.39* (1.57)
Read to	2.06*** (0.49)	1.84*** (0.52)	-0.10 (0.54)	0.93* (0.46)	-0.52 (0.48)	-0.74 (0.40)	-0.46 (0.40)	-0.55 (0.40)
Paint	1.07** (0.40)	1.63*** (0.43)	-0.03 (0.47)	0.03 (0.40)	0.77 (0.42)	-0.52 (0.47)	0.55 (0.46)	0.40 (0.46)
Reading	1.26*** (0.27)	0.07 (0.29)	-1.74** (0.61)	-0.34 (0.52)	-0.33 (0.53)	-2.09*** (0.28)	0.38 (0.28)	-0.71* (0.28)
Writing			-0.09 (0.44)	0.44 (0.38)	-0.21 (0.39)	-1.09** (0.34)	-1.19*** (0.34)	-0.47 (0.34)
Library	0.93* (0.46)	-0.10 (0.49)	0.16 (0.65)	1.42* (0.55)	0.77 (0.58)	1.21 (0.64)	0.10 (0.63)	0.25 (0.63)
Counting	1.22** (0.38)	0.76 (0.41)	0.10 (0.46)	-0.18 (0.39)	0.11 (0.40)	1.11** (0.35)	-0.03 (0.35)	0.01 (0.35)
Father read	2.18*** (0.46)	1.64*** (0.41)	0.88* (0.46)	1.95*** (0.39)	0.24 (0.40)	0.96** (0.35)	0.07 (0.35)	0.24 (0.35)

<b>PANEL B</b>	MCS2: age 3		MCS3: age 5			MCS4: age 7		
	1	2	3	4	5	6	7	8
	<i>Test</i>	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)
	(0.33)	(0.35)	(0.42)	(0.36)	(0.38)	(0.36)	(0.36)	(0.36)
Bed time	1.61***	0.41	0.37	1.15*	0.30	1.96***	0.96	0.82
	(0.45)	(0.48)	(0.61)	(0.52)	(0.55)	(0.56)	(0.56)	(0.55)
TV	-0.74	2.32***	-1.95**	0.30	-1.96***	-2.47***	-0.68	-1.82**
	(0.58)	(0.62)	(0.66)	(0.57)	(0.59)	(0.61)	(0.61)	(0.61)
Smack	-1.32*	-0.57	1.29	0.16	-0.12	-1.75**	-1.11	-1.11
	(0.56)	(0.60)	(0.66)	(0.57)	(0.60)	(0.64)	(0.65)	(0.64)
Shout	0.28	1.21	-0.00	-0.37	0.46	0.07	-0.78	0.51
	(0.72)	(0.77)	(0.88)	(0.75)	(0.78)	(0.81)	(0.81)	(0.80)
PPS	0.58**	0.73***						
	(0.19)	(0.20)						
NPS	0.01	-0.07						
	(0.07)	(0.07)						
constant	-28.11**	-26.46*	84.59***	53.59***	125.20***	105.48***	7.67	-91.26***
	(10.34)	(11.03)	(10.34)	(8.79)	(9.76)	(12.18)	(12.97)	(12.36)

**Table A2: Cognitive development and the persistence of poverty: Table 5, Panel B**

<b>PANEL B</b>	MCS2: age 3		MCS3: age 5			MCS4: age 7		
	<i>Test</i>	1	2	3	4	5	6	7
	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)	PiM(7)
PPM	-4.64*** (0.70)	-3.99*** (0.74)	-1.20* (0.52)	-2.22*** (0.46)	-0.90 (0.50)	-2.47*** (0.34)	-1.05** (0.37)	-1.75*** (0.35)
Age	1.02*** (0.18)	0.65*** (0.19)	-0.44** (0.15)	-0.25* (0.12)	-1.28*** (0.14)	-0.60*** (0.13)	0.38** (0.14)	1.57*** (0.13)
Birth weight (in Kilos)	0.44 (0.70)	1.92** (0.73)	-0.04 (0.79)	1.23 (0.72)	3.28*** (0.78)	1.16 (0.73)	3.90*** (0.79)	2.93*** (0.75)
Mixed ethnicity	0.24 (2.70)	1.65 (2.84)	2.93 (3.07)	0.71 (2.79)	3.27 (3.04)	7.23* (2.84)	-1.74 (3.09)	0.82 (2.90)
Indian	-2.87 (4.08)	-14.16*** (4.28)	-3.08 (4.61)	-9.19* (4.19)	-0.91 (4.56)	10.47* (4.28)	-3.21 (4.66)	-2.15 (4.37)
Pakistani and Bangladeshi	-10.08 (5.96)	-28.37*** (6.26)	-6.39 (6.80)	-19.28** (6.17)	1.92 (6.72)	18.04** (6.31)	5.73 (6.87)	-6.98 (6.45)
Black or Black British	-7.39 (5.38)	-21.13*** (5.65)	1.43 (6.10)	-20.78*** (5.53)	0.32 (6.03)	10.61 (5.64)	-17.10** (6.14)	-0.43 (5.76)
Other ethnic groups	2.60 (6.91)	-32.49*** (7.26)	-11.14 (7.85)	-14.36* (7.13)	0.41 (7.77)	-5.92 (7.28)	-12.52 (7.93)	2.19 (7.44)
Mother works	0.66 (0.78)	0.59 (0.83)	0.29 (0.96)	0.55 (0.83)	-0.72 (0.87)	0.59 (0.93)	-0.30 (0.94)	0.88 (0.92)
NVQ1	0.23 (2.48)	3.06 (2.62)	-0.79 (3.03)	7.99** (2.71)	-2.86 (2.94)	0.73 (2.95)	0.21 (3.18)	-0.76 (3.00)
NVQ2	4.30* (2.00)	6.19** (2.11)	1.41 (2.45)	5.77** (2.19)	4.67* (2.37)	4.82* (2.39)	4.97 (2.57)	4.19 (2.44)
NVQ3	5.44** (2.11)	7.87*** (2.23)	2.86 (2.56)	6.73** (2.29)	3.90 (2.48)	5.29* (2.49)	4.88 (2.67)	5.38* (2.53)
NVQ4	9.20*** (2.01)	9.63*** (2.13)	5.18* (2.46)	14.31*** (2.20)	7.97*** (2.38)	9.66*** (2.38)	9.01*** (2.56)	8.89*** (2.43)
NVQ5	12.31*** (2.50)	5.59* (2.65)	8.15** (2.72)	11.78*** (2.41)	5.77* (2.61)	9.98*** (2.63)	10.42*** (2.81)	9.05*** (2.68)
Kessler	-0.16 (0.12)	0.02 (0.13)	-0.09 (0.14)	-0.20 (0.12)	-0.11 (0.12)	-0.28* (0.12)	-0.14 (0.13)	-0.09 (0.12)
Tenure	-3.43** (1.31)	-4.91*** (1.39)	-1.54 (1.61)	-3.37* (1.42)	-2.76 (1.53)	-3.46* (1.53)	-3.22* (1.63)	-4.18** (1.55)
Read to	2.06*** (0.49)	1.85*** (0.52)	-0.10 (0.54)	0.93* (0.46)	-0.51 (0.48)	-0.71 (0.40)	-0.43 (0.40)	-0.53 (0.40)
Paint	1.08** (0.40)	1.63*** (0.43)	-0.01 (0.47)	0.03 (0.40)	0.77 (0.42)	-0.56 (0.47)	0.53 (0.46)	0.38 (0.46)
Reading	1.26*** (0.27)	0.08 (0.29)	-1.72** (0.61)	-0.35 (0.52)	-0.32 (0.53)	-2.10*** (0.28)	0.37 (0.28)	-0.70* (0.28)
Writing			-0.13 (0.44)	0.44 (0.38)	-0.21 (0.39)	-1.15*** (0.34)	-1.22*** (0.34)	-0.52 (0.34)
Library	0.92* (0.46)	-0.10 (0.49)	0.16 (0.65)	1.44** (0.55)	0.77 (0.58)	1.19 (0.64)	0.08 (0.63)	0.25 (0.63)
Counting	1.23** (0.38)	0.76 (0.41)	0.11 (0.46)	-0.18 (0.39)	0.11 (0.40)	1.17*** (0.35)	-0.00 (0.35)	0.04 (0.35)
Father read	2.19*** (0.33)	1.63*** (0.35)	0.90* (0.42)	1.95*** (0.36)	0.24 (0.38)	0.99** (0.36)	0.10 (0.36)	0.27 (0.36)
Bed time	1.61*** (0.45)	0.44 (0.48)	0.41 (0.61)	1.16* (0.52)	0.30 (0.55)	1.98*** (0.56)	0.96 (0.56)	0.82 (0.55)
TV	-0.73 (0.59)	2.32*** (0.62)	-1.95** (0.66)	0.34 (0.56)	-1.98*** (0.59)	-2.50*** (0.61)	-0.71 (0.61)	-1.85** (0.61)
Smack	-1.35* (0.56)	-0.57 (0.60)	1.32* (0.66)	0.15 (0.57)	-0.13 (0.60)	-1.78** (0.64)	-1.12 (0.65)	-1.14 (0.64)

<b>PANEL B</b>	MCS2: age 3		MCS3: age 5			MCS4: age 7		
	1	2	3	4	5	6	7	8
	<i>Test</i>	BSRA(3)	BAS-NV(3)	BAS-PS(5)	BAS-NV(5)	BAS-PC(5)	BAS-WR(7)	BAS-PC(7)
Shout	0.31 (0.72)	1.24 (0.77)	0.01 (0.88)	-0.37 (0.75)	0.48 (0.78)	0.17 (0.81)	-0.75 (0.81)	0.55 (0.81)
PPS	0.57** (0.19)	0.73*** (0.20)						
NPS	0.01 (0.07)	-0.07 (0.07)						
constant	-28.71** (10.34)	-26.72* (11.03)	84.57*** (10.34)	53.28*** (8.79)	124.56*** (9.76)	105.22*** (12.19)	7.27 (12.98)	-91.74*** (12.38)