



**Early child care and child outcomes:
the role of grandparents**
Evidence from the Millennium Cohort Study

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By Daniela Del Boca, Daniela Piazzalunga and Chiara Pronzato¹

Abstract:

In this paper, we focus on the impact of early grandparents' care on child cognitive outcomes, in the short and medium term, using data from the Millennium Cohort Study (UK). Compared with children looked after in a formal care centre, children cared by grandparents (as well as parents) are better in naming objects, but worse in tests concerning basic concepts development, problem-solving, mathematical concepts and constructing ability. These results hide strong heterogeneities: on the one hand, the positive association between family care and child outcomes is stronger for children in more advantaged households; on the other hand, the negative association is significant only for children in more disadvantaged households. In order to assess a causal link between early care and child outcomes, we employ panel methods and instrumental variables techniques. The results we obtain confirm the cross section results.

Keywords: Grandparents, Childcare, Child cognitive outcomes

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1. Introduction

Economic research on early child care and child development has grown rapidly over the last few years. An important debate has linked the decline in school and job performance in many advanced countries with insufficient and delayed investments in human capital (both public and private). In particular, analysis of the costs and benefits of the investments in human capital within various age ranges indicates that investments in the early years of life lead to better results than those made later. The later investments are made, in fact, the more expensive it is to remedy scholastic achievement and detrimental behaviour. Moreover, not only are investments made during the preschool period less costly, because they do not require remediation of previous deficits, but they are also more effective; indeed, individual abilities are more “malleable” in the early years of life and early investments can also have a cumulative effect over time, unlike those made later in life (Carneiro and Heckman, 2003; Cunha and Heckman, 2007).

Early child care plays an important role in the production of cognitive skills. What determines cognitive ability and behavioural development early in life is of crucial policy importance. While early psychological theories have stressed the need for maternal care, more recent studies in psychology as well as in sociology and economics show that other childcare arrangements do not necessarily produce negative outcomes. Whereas a substantial body of research has analysed the impact of parental and formal child care, the influence of other family members such as grandparents has received little attention. However, data available from several countries indicate that grandparents do play an important role in child care and show that quite a large proportion of grandparents provide some kind of care for grandchildren, even on a regular basis (Hank and Buber, 2009). This proportion has decreased over time in countries where subsidized universal public child care has become available (France, Norway, Sweden), while it has remained stable or increased in countries where less affordable formal child care is available and/or the economic crisis has been more severe.

The objective of this paper is to explore the impact on child outcomes of the most important substitutes for parents’ time, grandparents and formal child care (while also controlling for other childcare modalities). These are the two most important alternatives to parental care and represent two very different child care choices. We utilize the Millennium Cohort Study for the UK, which provides very detailed information about children, parents, grandparents,

childcare choices, as well as several child outcomes. We find that the effect of grandparental care is always in the same direction and never significantly different from parental care, and that children looked after by their grandparents are better at naming objects but worse at problem-solving, constructing objects, solving math exercises, and developing basic concepts compared to children looked after in formal childcare centres. However, there exist strong heterogeneities according to the socio-economic status of the family: the positive association of grandparents' care with naming abilities is stronger for households with higher income and education, while the negative association with construction abilities is stronger for households with lower income and education.

2. Literature

Much of the growing literature on childcare arrangements and child outcomes over the last few years has been influenced by the seminal work of Todd and Wolpin (2003) and James Heckman and co-authors (e.g. Carneiro and Heckman, 2003). They modelled children's outcomes (cognitive, health and behavioural) as the result of a production function in which inputs are provided by families as well as by other people and institutions (schools, teachers, peers, society). In their framework, child development is considered the outcome of a cumulative process of knowledge acquisition, analogous to a firm production process. These inputs play a very significant role, since cognitive and non-cognitive outcomes are largely determined early in life. The estimates of the impact of maternal employment on several child outcomes, such as attainment and years of schooling, are very different across different studies. Blau and Grossberg (1992), Ruhm (2004), Bernal (2008) report negative effects, while Del Boca et al. (2012) and Vandell and Ramanan (1992) report non-significant and positive impacts. The variability of these results depends on the child care alternative chosen by mothers as a substitute for their own time.

Using PSID data, Brilli (2013) analyses both the impact of mothers' time and childcare use and shows that while a reduction in maternal time with the child induces a negative effect on reading test scores, this can be compensated for by the use of an equal amount of external formal child care. Similarly, Brooks-Gunn et al. (2002) show that children whose mothers are working by the child's ninth month have lower cognitive development scores than the children of non-working mothers, but that high-quality child care can help counterbalance these effects. Loeb et al. (2007) find that reading scores of children attending a centre-based

arrangement are 1.2 points higher than those of children cared for by their parents, and their math scores were 2 points higher. Felfe and Lalive (2012) estimate the impact of child care attendance between 0 and 2 years of age in West Germany and find that attending prekindergarten has positive effects on both language and social skills, especially among households with less-educated mothers. Datta Gupta and Simonsen (2010) analyse the impact of formal child care in Denmark and find that preschool attendance is as good as home care regardless of the mother's level of education.

Other studies have focused on child care provided by other family members as substitutes for the mother's time. To start with, a large proportion of fathers are increasingly involved in childcare. Del Boca et al. (2014) analysed the impact of mothers' and fathers' inputs in the child development production function and have shown that fathers are as productive as mothers in child care, especially as the children get older, and make a significant contribution to their children's cognitive outcomes. Another important substitute for mothers' care is grandparents' care, although the significance of this form of caregiving has received little attention (Fergusson et al., 2008).

Hank and Buber (2009) have shown that in Western Europe 49 per cent of grandfathers and 58 per cent of grandmothers provide some kind of care for grandchildren; from 20 per cent to 48 per cent of them care for their grandchildren on a regular basis or more (Table1).

Table 1

In an interesting study of the choices people make between grandparents and formal child care, El Attar (2013) supplies an interpretation that hinges on trust towards other people and institutions. In her study focusing on the role of trust in childcare choices, she assumes that childcare options differ in their degree of "externalness", ranging from maternal to grandparental care, up to babysitter care and kindergarten. Grandparental child care is more often chosen by more traditional families with stronger intergenerational ties.

While grandparents have been considered as an important form of support for women's employment (García-Morán and Kuehn, 2012; Arpino et al., 2012), very little is known about their role in the child development process. To the best of our knowledge, the only paper that considers the impact of grandparental child care is Hansen and Hawkes (2009). They use 2 waves of the Millennium Cohort Study to compare the impacts of different childcare

alternatives (formal group, formal non-group, partner care, grandparents care and other informal care) on a vocabulary test and a school-readiness test, as well as on the behavioural development. They find that children who receive informal care from the mother's partner or from grandparents do better on vocabulary, but worst in terms of school readiness than children who receive formal child care. They also show that grandparental care increases behavioural problems. A recent report by Bryson et al. (2012) extends the analysis to the vocabulary test in the third wave of the Millennium Cohort Study. They do not find any significant effect of being cared by grandparents on naming abilities at age 5, while the impact of grandparental care on behaviour has different direction depending on the level of education of the mother. Their results imply that any association with childcare used in earlier years disappears in the medium term.

These results cannot be read in causal terms, however, nor can they be generalized to the whole UK population, since the analysis is limited to families with working mothers. In our paper, we extend the analysis to the whole sample of mothers (working and non-working) and we use more details from a greater number of waves (child cognitive outcomes at 3, 5 and 7 years of age) and a larger number of cognitive outcomes. We add to the School Readiness and the Naming Vocabulary test used to assess the basic concept development and the spoken vocabulary of the child, the Picture Similarity test and the Pattern Construction, which measures children's problem solving abilities and child's accuracy and speed in constructing designs, and Word reading and Number skills, which are indicators of abilities in language and math when children grow up.

Finally, in order to address the potential endogeneity of child care and to provide a more causal interpretation of the relationship between early child care and child outcomes we use panel data methods and instrumental variable techniques.

3. Methodological framework

The relationship between different types of child care and child development can be described by a household production function that explains how parental inputs (time and money) and other inputs translate into child outcomes. In Todd and Wolpin (2003), both family and external inputs are important determinants of child development and the impact depends on the timing of the investments. The human capital production function can be written as:

$$k_{ija} = (k_{t-1}, H_{ija}, S_{ija}, \hat{a}_{ija}) \quad (1)$$

where k_{ija} is a measure of the cognitive achievement of child i in household j at age a , k_{t-1} is child's past early cognitive ability, or child endowment, H_{ij} is the vector of past and current family inputs up to age a , S_{ija} is the vector of present and past school inputs and \hat{a}_{ija} is the measurement error of the cognitive achievement. The function that translates family and school inputs into children's outcomes is allowed to depend on child's age a . In Todd and Wolpin's model, the timing of the investment matters, since the same investment made at different ages could lead to different results. However, acquired skills are stable over time and investments made in different periods do not interact with each other.

Our specification corresponds to the cumulative specification in Todd and Wolpin. The current output of the production process is likely to depend also on the history of previous inputs as well as on the child's initial endowment. By including the past output of the child production function in the estimated equation k_{t-1} , we control implicitly for the set of past inputs as well as for the child initial endowment.

In our framework, child outcomes depend both on parental child care as well as on other forms of non-parental care available. The availability of non-parental care can change the amount of time parents spend with their children and its effect on child development. We assume, as in most empirical studies based on the production function approach, that k is an additive separable function of parental time, non-parental care, family characteristics, child characteristics and an i.i.d. disturbance.

In our analysis, we distinguish the household inputs H in their different components, the inputs that come from mothers and fathers (P_{ijl}) and the inputs from the grandparents (G_{ijl}). The education production function can thus be written as:

$$k_{ija} = (k_{ij0}, P_{ij1}, G_{ij1}, S_{ij1}) \quad (2)$$

where a is the age in which outcomes are measured, 0 is the initial endowment (when the child is 9 months old), 1 is the period in which we measure inputs from family and external child care (18 months). This production function is similar to that considered in previous

works on child cognitive development, with the main difference being that it includes the investments made by the grandparents themselves in addition to the usual inputs from parents and school. The estimation of the child production function implies several problems, perhaps the most important one being that family inputs are likely to be chosen by the family itself also in response to child achievements and child quality, and are therefore endogenous. Mothers' and fathers' time, in fact, may depend on the parents' perception of the child's needs, as proxied by the child achievements. If the child performs poorly, parents might react by spending more time with her/him. On the other hand, parents might allocate more time to talented children, since it is a more enjoyable experience, and in so doing may further encourage their child's achievements. Even after controlling for past inputs, for child initial endowment and for current school inputs, the estimated effect of simultaneous parental time on child outcome could be incorrect, namely because it could be both biased and inconsistent due to endogeneity issues.

By assuming that the production function is additively separable, linear in its arguments and invariant during the period, we can estimate the following equation

$$K_{i,a} = \beta_0 + K'_{i,9}\beta_1 + C'_{i,18}\beta_2 + X'_{i,9}\beta_3 + Z'_{i,a}\beta_4 + \varepsilon_{i,a} \quad (3)$$

Where

- $K_{i,a}$ is the cognitive outcome of the child i when she is a years old ($a = 3, 5, 7$);
- $K'_{i,9}$ is a vector of early child endowment / development variables (motion, motor and communication development) of the child i when she is 9 months old;
- $C'_{i,18}$ is a vector of childcare modalities experienced by the child i when she is 18 months old;
- $X'_{i,9}$ is a vector of time-invariant characteristics of the child i and her family measured when she is 9 months old
- $Z'_{i,a}$ is a vector of time-varying characteristics of the child i and her family measured when she is a years old ($a = 3, 5, 7$);
- $\varepsilon_{i,a}$ is a random error normally distributed;
- $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ are the parameters to be estimated by OLS.

The main interest of the paper is in the estimation of β_2 , that is the effect of different childcare modalities on child cognitive outcomes. In particular, we are interested in comparing the effect of grandparents care and formal care, while controlling for any other childcare input (parents, child-minders, others). In this regard, the main assumption we are making is that the

random error $\varepsilon_{i,a}$ is uncorrelated with $C'_{i,18}$. However, parents make choices about childcare and there may be unobservable factors correlated with this decision that directly influence the outcomes. For example, more “schooling oriented” parents may choose early formal childcare, but they may also buy books for the child, read to him/her, and involve him/her in more educational activities. These activities may be not observable and may influence child cognitive outcomes, biasing our estimates. We propose three further empirical specifications, characterized by weaker assumptions, which should reinforce (or not) the evidence of a causal link between care modalities and child cognitive outcomes.

In the first specification, we add to model (1) past childcare decisions taken by parents and changes of childcare modalities over time. Most childcare modalities transitions happen by age 3 of the child and are recorded by the survey. We estimate the following equation

$$K_{i,3} = \beta_0 + K'_{i,9}\beta_1 + IC'_{i,9-36}\beta_{I2} + SC'_{i,9-36}\beta_{S2} + MC'_{i,9-36}\beta_{M2} + X'_{i,9}\beta_3 + Z'_{i,a}\beta_4 + \omega_{i,3} \quad (4)$$

Where

- $K_{i,3}$ is a vector of cognitive outcomes of the child i when she is 3 years old;
- $IC'_{i,9-36}$ indicates that a childcare modality has been introduced for the child i between 9 months old and 36 months old, that was not used when she was 9 months old;
- $SC'_{i,9-36}$ indicates that a childcare modality has been stopped for the child i between 9 months old and 36 months old, that was used when she was 9 months old;
- $MC'_{i,9-36}$ indicates that a childcare modality has been maintained for the child i between 9 months old and 36 months old;
- $\omega_{i,3}$ is a random error normally distributed;
- $\beta_0, \beta_1, \beta_{I2}, \beta_{S2}, \beta_{M2}, \beta_3, \beta_4$ are the parameters to be estimated by OLS.

Model (2) is an enriched version of model (1) where part of the unobserved heterogeneity across families is explained by including past childcare decisions and childcare changes over time. The interest here is in the estimation of β_{I2} , that is the effect of introducing a new childcare modality. For example, the effect of introducing formal care is identified by comparing outcomes of children who have started formal care with outcomes of children who have not started but with the same childcare patterns over time. The assumption we rely on is still strong: $\omega_{i,3}$ needs to be uncorrelated with $IC'_{i,9-36}, SC'_{i,9-36}, MC'_{i,9-36}$.

The third specification employs a linear regression with fixed effects by exploiting the availability of one cognitive outcome repeated over time. We estimate

$$K_{i,a} = \beta_0 + K'_{i,9}\beta_1 + C'_{i,a}\beta_2 + X'_{i,9}\beta_3 + Z'_{i,a}\beta_4 + u_i + \mu_{i,a} \quad (5)$$

Where

- $K_{i,a}$ is the cognitive outcome of the child i when she is 3 or 5 years old;
- $C'_{i,a}$ is a vector of childcare modalities experienced by age 3/5 of the child i ;
- u_i represents the personal/family effect of the child i , fixed over time;
- $\mu_{i,a}$ is a random error normally distributed.

By differencing the data available in the two waves, we can eliminate the personal/family effect u_i . That means that whatever is unobserved by the researcher (parental school orientation, for example) but is fixed over time, it is taken into account and does not bias our results. The assumption behind model (3) is therefore much weaker than the assumptions behind models (1) and (2).

However, parents may learn about their children over time and react to them. For example, parents' awareness that a child is not developing properly given her age may lead them to send the child to formal childcare and to take other actions that may influence her development too. To check whether this may be the case, we use an instrumental variables approach. We limit the sample to children cared by grandparents and looked after in a formal care centre, and estimate the following equations:

$$K_{i,a} = \beta_0 + K'_{i,9}\beta_1 + \beta_2 \hat{G}_{i,18} + X'_{i,9}\beta_3 + Z'_{i,a}\beta_4 + v_{i,a} \quad (6)$$

$$G_{i,18} = \gamma_0 + K'_{i,9}\gamma_1 + D'_i\gamma_2 + X'_{i,9}\gamma_3 + Z'_{i,a}\gamma_4 + e_{i,a} \quad (7)$$

Where

- $G_{i,18}$ indicates that the child i is mainly cared by grandparents (rather than in a formal care centre) when she is 18 months old;
- D'_i is our instrumental variable, the distance (in minutes) between the parental house and the grandparental house;
- $v_{i,a}$ and $e_{i,a}$ are a random errors normally distributed.

Instruments need to be relevant and valid to have credible results. While the relationship between geographical distance and the probability to be cared by grandparents is expected and easy to verify empirically, we need to argue the validity of the instrument. Living close / further away by grandparents is a decision and its unobservable determinants may also be related to child cognitive outcomes. Geographical distance has been often used (and criticized) when studying the impact of grandparental care on mother's employment. But while in that case it is easy to expect that more work-attached mothers choose to live close to grandparents to be helped and to be able to work, it is more difficult to think of an example in our case. We argue that there is no "systematic" reason why parents of children with better/worse cognitive outcomes should choose to live closer to grandparents. It could be the case that more "able" parents live further away because of more work opportunities and transmit their abilities to children. In this case, the instrument would be not valid. However, we control for parental education, employment, hours of work, and wages. Furthermore, in the UK it is quite common to move away from the original town, not only for people with better career prospects. There could be other differences – even if not systematic - between parents who live close/further to grandparents in the values, in the norms, which could affect the way they rear their children. We try to explore potential differences by exploiting data on values and beliefs from other survey data.

4. Data, sample, and variables

4.1. The Millennium Cohort Study

The Millennium Cohort Study (MCS) is a longitudinal survey conducted by the Centre for Longitudinal Studies that tracks the lives of a sample of about 19,000 babies born in the UK in the year 2000/2001. The survey is conducted in several waves, with the first one concentrating on the circumstances of the pregnancy and birth as well as the first few months of life. This first part of the survey also contains important information about the socio-economic background of the family in which the child is born. The second wave took place when the children were about 3 years old, and the main focus was on continuity and change in the family as well as the parenting environment to extract information about the child's development. In the third wave in 2006, the children were at the age to start primary school. The fourth wave took place in 2008, and the fifth in 2012.

4.2. The sample

In wave 1, the survey consists of 18,552 children. The effects of sample selection on the size and on the characteristics of our final sample are shown in Table 2: for each step in the selection process, we display the average characteristics which we will use throughout the paper and which will be explained in this section. First, we exclude 256 twins, since childcare arrangements and their effects may be different when more children have to be looked after. Second, we exclude 40 children whose main caregiver (who therefore answered the questions concerning the child) is not the mother. What remains is a sample of 18,256 observations, whose characteristics are summarized in the first column (“9 months old”) of Table 2.

Table 2

Not all of the families participated for the entire duration of the survey: we lose around 10% of the sample between the second and the third wave, and another 10% between the third and the fourth survey. From the first column (“9 months old”) to the second column (“3 years old”), more than 3,000 observations are lost because of attrition. Our main independent variable on childcare is constructed using information in wave 2 (when the child is 3 years old); however, a non-negligible number of mothers (around 2,000) did not answer these questions (probably because of a filter error in the questionnaire). This leads to the sample described in the third column (“3 years old, childcare variables”). The final sample is described in the last column (“7 years old, at least one outcome”) where we have also dropped children whose outcomes all resulted as missing. What remains is a sample of 10,001 observations. Is this sample representative of the initial one? If we compare the average characteristics, we observe some small but significant differences: in particular, we observe that mothers in our final sample are older (30 years old rather than 29), better educated (40% higher educated versus 33%), more likely to have had a job during pregnancy (70% versus 62%), more likely to be living with their partner (88% versus 82%), and slightly richer (weekly equivalent income 342 rather than 307).

4.3. Child outcomes

We study the effect of early childcare on eight outcomes: two measured at age 3, three measured at 5 and three measured at age 7. In the Millennium Cohort Study, child outcomes are measured in three ways. A first group of outcomes is measured by the interviewer through a standardized test and focuses on the child’s ability to perform certain tasks; a second group

is reported by the teacher (when the child is 5 and 7) and concerns abilities and behaviour at school; a third group is reported by the mother and regards the child's behaviour at home. We only consider the first group of outcomes, since it is more objective: mother's reports may lead to very biased results (for example, mothers may feel guilty about not staying at home and therefore be more lenient judges of the child's behaviour), while teacher-performed evaluations may be influenced by the other children in the class, which we are not able to take into account. We therefore estimate the effect of early care on the Bracken School Readiness assessment (age 3 of the child), on Naming Vocabulary (age 3 and 5), on Picture Similarity (age 5), on Pattern Construction (age 5 and 7), on Word Reading Score and the Number Skills (age 7).

The Bracken School Readiness assessment is used to assess the basic concept development in young children. BBCS-R measures the comprehension of 308 functionally relevant educational concepts in 11 subtests or concept categories. Only 6 subsets have been implemented in the MCS: colours (primary and basic), letters (knowledge of upper- or lower-case letters), numbers/counting (single and double-digits numbers and assigning a number to a set of objects), sizes (concepts that describe one, two and three dimensions), comparisons (the ability to match or differentiate objects), and shapes (including lines, circles, squares, cubes, and pyramids).

The Naming Vocabulary Verbal test assesses the spoken vocabulary of the child. Children are shown individual test items from booklets of colourful pictures of objects and asked to name the objects. The scale measures language ability, but picture recognition is also crucial. Low scores may also reflect reluctance to speak. For the Picture Similarity test, children are shown a row of 4 pictures on a page and asked to place a card with a fifth picture under the picture most similar to it. This assessment measures children's problem solving abilities.

The Pattern Construction test assesses the child's accuracy and speed in constructing a design by putting together flat squares or solid cubes with black and yellow patterns on each side. In the Word Reading test the child reads a series of words presented on a card out loud, thus giving an indication of his or her reading skills. The Number Skills test is adapted from the NFER Progress in Math test. In this assessment, children complete various tasks, covering the topics of numbers, shape, space and measures, and data handling.

Table 3

Table 3 reports the descriptive statistics of the outcomes of interest. The outcomes are age-based and standardized.

4.4. Childcare variables

The main respondent was asked about the childcare choices made. In the first survey, when the child was 9 months old, working mothers were asked to state the types of care being used while they were at work, at the time of the survey. In the second survey, when the child was 3 years old, all of the mothers were asked details about the type of childcare used since the first survey, including starting dates, stop dates, and the number of hours per week.

We use information from the second survey to create a more representative sample (working and non-working mothers) and to have information also on the hours of used types of care. We classify the answers into five broad categories: parental care, grandparental care, formal care, child-minder, and other childcare. Because we know the average weekly number of hours for each, we can also define the “main” type of childcare used. We also define a sixth category “no arrangements” for children whose parents have never arranged any other type of childcare. The category “parental care” is different, and indicates that although the mother works, she can either look after the child while working or the partner looks after the child while she is at work.

In order to measure childcare inputs at the same time for all children in the survey, we chose a point in time between the first two surveys: we look at childcare choices when the child is 18 months old, which is before the second survey where we measure the first outcomes (the youngest child who participates in the second survey is 25 months old at the time of the interview) and which is after the first survey (the oldest child who participates in the first survey is 12 months old at the time of the interview).

Table 4

Table 4 describes parental childcare choices when the child is 18 months old: column 1 indicates the percentage of children receiving that kind of care, column 2 shows the average

number of hours per child using that kind of care, and column 3 shows the percentage having a certain kind of care as main care. In particular, 22% of children are looked after by their grandparents, for an average of 20.9 hours a week, and this is the main childcare arrangement for 19% of children. It is interesting to observe that among children not looked after by their parents, grandparental care is the most common choice.

We also considered childcare choices at other points in time. However, childcare choices seem highly consistent over time (Table 5): for most children, the main type of childcare used at 12 months is the same as that used at 24 months.

Table 5

This is particularly true for children looked after by parents, grandparents, or in formal childcare centres, with the probability of being looked after in the same way being at least 85%.

4.5. Control variables fixed over time

We control for a large number of variables, measured when the child is 9 months old and described in Table 2 (last column). We consider the child's characteristics (being British, being a girl, birth-weight, whether s/he was breastfed for at least 1 month, accidents at home, having been in a hospital, and three indicators of child development²); household's characteristics (other siblings, weekly equivalent income, if parents meet friends at least once a week, region of residence); mother's characteristics (age, high education, age she left education, hours of work per week, whether she held a job while pregnant, monthly wage, not employed, whether she experienced post-partum depression, a factor summarizing her feelings of tiredness and concern, a factor summarizing her feelings of irritability, whether she had lived with a single mother during childhood, whether she has a chronic illness, cigarettes smoked per day, whether she drinks at least once a week); father's characteristics (whether he is present, hours of work per week, monthly wage, a factor summarizing his feelings of tiredness and concern, a factor summarizing his feelings of irritability, whether he had lived

² We include three factors derived from analyzing a battery of questions through a factor analysis. Examples of questions and answers are: "s/he waves bye-bye on her/his own when someone leaves", "s/he can pick up a small object using forefinger and thumb only", "s/he can sit up without being supported"; answers are "often", "once or twice", and "not yet".

with a single mother during childhood, cigarettes smoked per day, whether he drinks at least once a week).

In order not to lose too many observations, we replace missing observation of the control variables with 0 and construct four missing variable indicators (for the child, the household, the mother, the father).

4.6. Time-varying control variables

In our empirical analysis we also control for a number of variables which may vary over time and may influence childcare decisions as well as child outcomes: the presence of the father at home, the presence of a new partner of the mother at home, household income, and the arrival of new siblings (described in Table 6).

Table 6

As expected, the percentage of separated parents increases over time, income increases, and the probability of having an additional child decreases. We also control for the child's age (in months), since children are not all interviewed exactly at the same age, but this has to be taken into account when considering their scores³.

5. Empirical results

5.1 Cross section analysis

Tables 7-9 list the main results. We estimate the effect of early care (when the child is 18 months old) on cognitive outcomes at age 3 (Table 7), at age 5 (Table 8), and at age 7 (Table 9). For each outcome, we show the estimated coefficients of three different models: in the first one ("Any"), we estimate the effect of the child having experience of each type of childcare; in the second model ("Hours"), we estimate the effect of weekly hours the child is cared for in each type of childcare; in the third model ("Main"), we estimate the effect of the main (in terms of hours) type of childcare (formal childcare is the excluded category).

³ Even though score are standardized according to the age of the child, some differences among children of different age where still evident, so that we prefer to include age as a control.

Concerning School readiness, in Table 7 (3 years old), we observe a positive effect of being looked after in a formal care centre (regardless of the number of hours), while an increasing number of hours spent with grandparents worsen it. Even if the estimated coefficients are almost never significant in the “Main” column, the signs are all negative when compared to formal care (excluded category). On the other hand, being looking after by grandparents (as well as by parents) positively affects the Naming vocabulary at age 3: being cared for within the family (also as the main type of childcare) has a positive strong effect on the ability to name objects, while an increasing number of hours spent in formal childcare, or at home with other people, decreases it.

Table 7

Table 8 reports the results of the same specifications at age 5. For this age, we have access to more outcomes: Naming vocabulary, Pattern construction and Picture similarity. The positive effect of grandparental care on Naming vocabulary seems to persist over time. Results in the “Any” specification suggest that the child spending time with adults at home (grandparents, parents, and child-minders) improves the ability of giving names to things. However, no longer do we see negative effects of hours spent with people outside of the family or differences of being cared mainly in one way than in another: while children looked after by family members were significantly “better” when they were 3, this performance gap narrows when they are 5 years old. On the other hand, we observe a strong positive effect of formal care (increasing in the number of hours) on Picture similarity, test that measures the development of problem-solving abilities.

Table 8

Table 9 reports the results at age 7 on the available outcomes: Pattern construction, Word reading and Number skills. We observe very few significant effects here. We only find that having had some experience of formal childcare has a positive impact on Number skills.

Table 9

We have also estimated heterogeneous effects of early childcare types for families with equivalent household income either below or above the median⁴. The estimated results in Table 10 are reported for children at age 3, 5, and 7 confirm earlier analysis by Hansen and Hawkes (2009) for age 3.

Table 10

The positive effect of grandparental care on Naming vocabulary (at age 3) is confirmed, but only for children from more advantaged backgrounds. On the other hand, the negative effects of grandparental care (compared to formal care) on School Readiness (at age 3), Picture Similarity at age 5, and Number skills (at age 7) are confirmed, but only for children from more disadvantaged backgrounds. Finally, a negative effect of grandparents' care (as well as parents' care) on Pattern construction emerges for children in more disadvantaged families. Being cared in a formal care centre seems to be more important for children of relatively poorer families.

5.2 Changes over time

Most of the transitions between different modes of care happen before age 3 for which, however, we do not have repeated outcomes. We try to exploit the transitions between different early childcare types between wave 1 (when the child is around 9 months old) and wave 2 (when the child is around 3 years old), and estimate their effects on outcomes in wave 2 (at age 3). The advantage is to make the regression richer by including more information on past childcare decisions in the models. By exploiting the usual questionnaire on childcare in wave 2, we reconstruct all types of childcare experienced by the child in wave 1 (around 9 months old) and in wave 2 (around 3 years old). For example, some children have been looked after by grandparents in both waves, some have never been looked after by grandparents, some start being looked after by grandparents in wave 2, and some stop being looked after by grandparents in wave 2. We can observe these transitions for all types of childcare. In particular, we are interested in comparing the outcomes of children who experience a new childcare type in wave 2 with children who never experience it between

⁴ Results are similar when dividing the sample by parental education (at least one parent with tertiary education versus all the others).

wave 1 and wave 2. Econometrically, this corresponds to the estimated coefficients of “start being looked after by...” when the excluded category is “never being looked after by...”. Substantially, this means comparing outcomes of children for whom childcare decisions when they were very young (9 months old, wave 1) were the same and for whom new types of childcare may have been introduced in wave 2. The idea is to have a “control” group very similar to the “treatment” group because of the same previous childcare decisions.

Table 11

Table 11 reports the results: we see that children who have started formal childcare between 9 months old and 3 years old perform better in School readiness and worse in Naming vocabulary than children – with the same childcare experiences – who have not started formal childcare. The positive effect on School Readiness is confirmed for children in families with equivalent household income below the median, while the negative effect on Naming vocabulary is confirmed for children in families with equivalent household income above the median.

5.3 Panel Data and IV methods

In the main results (Tables 7-10), we have shown the association between early childcare experiences and later child cognitive outcomes. However, results can be biased because of unobservables correlated with the childcare choice. We report here the results with fixed effects and with the instrumental variable approach, which can lead to a causal interpretation.

We first employ fixed effects model by exploiting outcomes that are repeated over time: Naming vocabulary (age 3 and 5) and Pattern construction (age 5 and 7) are available in the data. However, there are no transitions in different “early” childcare types between age 5 and 7. There are, however, between age 3 and 5. We used, so far, only childcare information from wave 2 (when the child is around 3 years old). In the third wave, when the child is around 5 years old, parents are asked whether the child has ever been in an early formal childcare centre or ever been looked after by a child-minder. We can therefore observe how many children start having these two childcare experiences: in wave 2 (around 3 years old) 30% of children had experienced formal childcare and 6% had experienced a child-minder; by wave 3 (around 5 years old) 78% of children have experienced formal childcare and 15% have

experienced a child-minder. We select the sample of children who, in wave 2 – at around 3 years of age – have only had the experience of family care (parental care and/or grandparental care, or no care arrangements), and compare improvements in the naming ability of those who continue to have only family care and those for whom formal care or child-minders have been introduced. By employing a linear regression with fixed effects, we can take into account unobservable factors that are fixed over time. The results are shown in Table 12.

Table 12

We observe that children who have started formal care develop their naming ability less than children who have been looked after in the family the whole time. This confirms the causal impact of grandparents' and parents' care on this kind of ability. The heterogeneous effects show that grandparents' and parents' care has a positive impact only for children in more advantaged backgrounds (family care being the excluded category): this confirms the positive impact of family care (i.e. parents' and grandparents' care) on naming vocabulary only for children from more advantaged background, which we have found with the OLS.

The previous methods rely on the assumption that the introduction of a new type of care is not related to any factor which may influence the outcomes directly. Therefore, we also try to use an instrumental variable approach which allows us to take into account endogeneity issues. As an instrument we use the distance – in minutes - between parents' house and grandparents' house. To make sure of the validity of the instrument, in the regressions, we control for a large number of variables which could be correlated with the decision of living close to grandparents and could affect directly the outcomes of interest: parents' education, employment, wages, and hours of work. However, there could be other unobservable characteristics which could affect both processes. We explore, in Table 13, other sources of possible heterogeneity: using data from the British Household Panel Survey, we compare the opinions of mothers living close/further from grandparents. We select women close to motherhood (2 years before/after the birth of a child) and summarize opinions regarding the family and the children, assuming that potential differences in the opinions could reflect differences in the way the parents rear their children. Table 13 shows that mothers living close/further from grandparents share most opinions.

Table 13

Table 14 shows, always using data from the British Household Panel, that there is no tendency in the UK to move close to grandparents when women have a child. Women close to motherhood are more likely to move than other women, but for reason related to the accommodation and the area.

Table 14

Table 15 compares OLS for the sub-sample used and IV estimates. In column 1, we report the OLS estimates of the effect of having grandparents as the main source of care compared to be in a formal care centre: we observe a positive association with Naming vocabulary at age 3, while a negative one with School readiness (age 3), Picture similarity (age 5) and Number skills (age 7). In column 2, we report IV estimates: on those outcomes the signs of the effects are confirmed and the effect on Picture similarity is significantly different from zero. Column 3 shows that the instruments used are relevant.

Table 15

The IV heterogeneous effects presented in Table 16 (second column) confirm the direction, and often the statistical significance, of the OLS heterogeneous effects (first column). Only for Pattern Construction the IV method reverses the direction of the effect, suggesting a positive – but not significant effect of grandparents’ care – instead of a negative significant one estimated with OLS.

Table 16

5.4 Robustness checks

In our main specification, we only include the childcare decision at one point in time: 18 months old. This decision may be correlated with other subsequent childcare/educational choices, which probably affect child outcomes and which may “take away” the observed effect of early childcare at 18 months. We then repeat the regressions for outcomes measured at age 5 and at age 7: for outcomes at age 5 we include a variable indicating early formal care after the age of 18 months, and for outcomes at 7 we also include being in preparatory school

at age 5. We report the significant effects found in our main models (Tables 7-9, “any”) in column 1 of Table A1 in the Appendix and the corresponding estimates when controlling for these variables in columns 2 and 3. Results are confirmed.

Finally, we chose childcare modalities when the child is 18 months old because – given the questions in wave 1 and 2 – it seemed to be a point in time for which we could derive reliable information. We have also measured childcare types at 12 and 24 months, but we cannot include them in the regressions because we would have multi-collinearity problems. However, we can check how results are sensitive to this choice: in Table A2 in the Appendix, we show that by including childcare at 12 or 24 rather than 18 months does not change the overall results. One effect of interest (i.e. grandparental care, parental care, or formal care), which loses statistical significance, is the one related to Picture similarity when we use childcare at 24 months: for the development of this ability, probably, it is important that the child starts attending formal care relatively early in age. Also, the positive impact of formal care on Number skills is not significant if we choose different point in time, an effect which was already estimated quite imprecisely.

6. Conclusions

In this paper, we analysed the effect of grandparents’ early care on later cognitive outcomes in the short term and the long term.

Grandparental care has a positive impact on child vocabulary which is stronger for children from advantaged background. It has a negative impact on School readiness, Pattern construction, Number skills, stronger for children from disadvantaged background. We also found a negative effect of grandparents’ care – with respect to formal care – on the solving problem ability of children, regardless of their family background. Panel methods and IV estimations confirm these results.

Early childcare may have therefore an important role in the cognitive development of children regardless of subsequent childcare or educational decisions. We believe that our results are likely to be important for policy purposes: in particular, the finding that most associations between early care and later cognitive outcomes may depend on the family background should be taken into account when thinking about the role of formal care. The consideration

of all family inputs is crucial to understanding the degree of substitutability between inputs from formal and family childcare.

Tables

Table 1: Percentage of grandparents helping in childcare

Country	Daily (%)	Weekly (%)
Greece	28.0	48.9
Italy	33.1	47.6
Germany	15.0	43.2
The Netherlands	2.3	42.9
Spain	24.3	37.5
Austria	14.6	35.6
UK	-	35.0
France	9.4	29.7
Denmark	1.6	22.0
Sweden	2.9	21.4
Observations	3,521	

Notes: statistics on a sample of grandparents with at least one grandchild younger than 14 years old.
Source: SHARE, 2004.

Table 2: Sample selection

Variable	9 months old Singleton Mother resp.	3 years old	3 years old Care variables	5 years old	7 years old At least one outcome
Child					
British	0.81	0.83	0.84	0.85	0.85
Girl	0.49	0.49	0.49	0.49	0.50
Age child (wave 1)	9.7	9.7	9.7	9.7	9.7
Birth-weight	3.4	3.4	3.4	3.4	3.4
Breastfed 1 month	0.45	0.47	0.48	0.49	0.50
Injuries	0.08	0.08	0.08	0.08	0.08
Hospital	0.20	0.19	0.19	0.18	0.17
Communicative dev.	0.01	-0.01	-0.03	-0.04	-0.05
Motor development	0.01	0.01	0.02	0.02	0.02
Motion development	0.00	0.02	0.03	0.05	0.06
Household					
Siblings	0.94	0.94	0.94	0.93	0.92
Equiv. weekly income	307	321	327	334	342
Meet friends every week	0.70	0.71	0.71	0.71	0.72
England	0.62	0.63	0.63	0.63	0.63
Wales	0.15	0.15	0.15	0.15	0.15
Scotland	0.13	0.12	0.12	0.12	0.12
Northern Ireland	0.10	0.10	0.10	0.10	0.10
Mother					
Age	29	29	30	30	30
High educated	0.33	0.36	0.37	0.38	0.40
Age left education	17	17	18	18	18
Job during pregnancy	0.62	0.65	0.67	0.68	0.70
Weekly hours of work	25	25	25	25	25
Monthly wage	931	950	939	948	957
Not employed	0.56	0.53	0.50	0.48	0.47
Post-partum depression	0.25	0.24	0.24	0.24	0.24
Tired and worried	0.00	-0.01	-0.02	-0.02	-0.02
Nervous	0.00	-0.02	-0.04	-0.04	-0.05
Difficult childhood	0.30	0.29	0.29	0.28	0.28
Long illness	0.21	0.22	0.21	0.21	0.22
Cigarettes per day	3.3	3.2	3.1	3.0	2.9
Alcoholic drinks	0.36	0.38	0.38	0.39	0.40
Father					
At home	0.82	0.85	0.86	0.87	0.88
Weekly hours of work	42	42	42	42	42
Monthly wage	1,964	2,012	1,986	1,997	2,011
Tired and worried	0.00	-0.01	-0.02	-0.03	-0.04
Nervous	0.00	0.00	0.01	0.01	0.01
Difficult childhood	0.24	0.23	0.23	0.23	0.23
Long illness	0.20	0.20	0.20	0.20	0.21
Cigarettes per day	4.7	4.5	4.5	4.4	4.4
Alcoholic drinks	0.41	0.44	0.46	0.47	0.49
Missing					
Child variables	0.01	0.01	0.01	0.01	0.01
Household variables	0.09	0.08	0.08	0.08	0.07
Mother variables	0.13	0.12	0.12	0.12	0.12
Father variables	0.28	0.27	0.27	0.27	0.27
Observations	18,256	14,668	12,639	11,278	10,001

Notes: sample selection due to attrition and other selection criteria: only singletons, mother respondent when the child is 9 months old, childcare variables not missing, at least one child outcome not missing. Child's development variables (communicative, motor, and motion) and parents' mental wellbeing (tired and worried, nervous) are factor points derived from factor analyses (see Appendix). The bottom part of the Table displays the percentage of children, households, mothers, and fathers with any missing information.

Table 3: Children outcomes

Variable	Observations	Mean	Std. dev.	Min	Max
Age 3					
School readiness	9,088	105	16	56	149
Naming vocabulary	9,498	50	11	20	80
Age 5					
Naming vocabulary	9,906	55	11	20	80
Pattern construction	9,874	51	10	20	80
Picture similarity	9,891	56	10	20	80
Age 7					
Pattern construction	9,817	54	11	20	80
Word reading	9,729	112	18	55	145
Number skills	9,857	10	3	0	15

Maximum number of observations: 10,001.

Table 4: Childcare choices when the child is 18 months old

	Any care	Users' hours of care	Main care
No arrangements	0.46	-	0.46
Parents	0.17	21.4	0.14
Grandparents	0.22	20.9	0.19
Formal care	0.13	22.5	0.11
Child-minder	0.07	25.2	0.06
Other	0.05	19.7	0.04

Notes: "Users' hours of care" (fourth column) reports the average number of hours by type of care considering only children who receive that type of care. Observations: 10,001.

Table 5: Childcare choices between age 1 and age 2 of the child

1 year old	2 years old	Formal care	Parents	Grandparents	Child-minder	Others	No arrangements
Formal	0.91	0.00	0.01	0.01	0.01	0.00	0.07
Parents	0.03	0.85	0.01	0.01	0.02	0.01	0.08
Grandparents	0.04	0.01	0.01	0.85	0.01	0.01	0.10
Child-minder	0.05	0.00	0.01	0.01	0.79	0.01	0.15
Others	0.05	0.02	0.01	0.01	0.03	0.71	0.17
No arrangements	0.05	0.02	0.02	0.03	0.02	0.01	0.89

Observations: 10,001.

Table 6: Time-varying control variables

Variable	Sweep 2	Sweep 3	Sweep 4
Age child (in months)	38	63	87
Father at home	0.84	0.80	0.77
Step-father at home	0.01	0.03	0.04
New-born siblings	0.26	0.18	0.11
HH annual income	27,038	29,130	32,053
Income missing	0.13	0.09	0.10

Observations: 10,001.

Table 7: Early childcare and child outcomes (age 3)

	School readiness			Naming vocabulary		
	Any	Hours	Main	Any	Hours	Main
No arrangements	0.83 (0.63)		-0.74 (0.56)	0.51 (0.43)		1.06*** (0.38)
Parents	0.54 (0.57)	-0.02 (0.02)	-0.92 (0.61)	0.84** (0.39)	-0.01 (0.01)	1.45*** (0.42)
Grandparents	0.74 (0.57)	-0.03* (0.02)	-0.82 (0.56)	1.25*** (0.39)	0.01 (0.01)	1.57*** (0.38)
Formal care	1.69*** (0.61)	0.02 (0.02)		-0.52 (0.42)	-0.05*** (0.01)	
Child-minder	0.24 (0.73)	-0.06*** (0.02)	-1.22* (0.71)	-0.01 (0.49)	-0.04*** (0.01)	0.53 (0.48)
Others	0.42 (0.78)	-0.07** (0.03)	-1.43 (0.89)	0.04 (0.54)	-0.05** (0.02)	0.64 (0.59)
Observations		9,088			9,498	
R squared	0.24	0.24	0.24	0.24	0.24	0.24

* p-value <0.10, ** p-value < 0.05, *** p-value <0.01

Table 8: Early childcare and child outcomes (age 5)

	Naming vocabulary			Pattern construction			Picture similarity		
	Any	Hours	Main	Any	Hours	Main	Any	Hours	Main
No arrangements	0.14 (0.41)		-0.38 (0.37)	0.78** (0.40)		0.02 (0.37)	0.54 (0.43)		-0.90** (0.39)
Parents	0.52 (0.36)	-0.00 (0.01)	-0.12 (0.39)	0.36 (0.36)	-0.02* (0.01)	-0.65* (0.39)	0.38 (0.38)	0.00 (0.01)	-1.22*** (0.41)
Grandparents	0.75** (0.36)	0.01 (0.01)	0.18 (0.36)	0.49 (0.36)	-0.00 (0.01)	-0.25 (0.36)	0.46 (0.39)	0.00 (0.01)	-1.04*** (0.38)
Formal care	0.40 (0.39)	-0.00 (0.01)		0.62 (0.38)	0.00 (0.01)		1.28*** (0.43)	0.04*** (0.01)	
Child-minder	0.88* (0.48)	0.01 (0.02)	0.18 (0.48)	0.84* (0.47)	-0.00 (0.01)	0.18 (0.47)	0.60 (0.50)	0.01 (0.02)	-0.81 (0.49)
Others	-0.72 (0.51)	-0.03 (0.02)	-1.03* (0.59)	0.23 (0.53)	-0.04 (0.02)	-0.44 (0.62)	0.14 (0.55)	-0.01 (0.02)	-0.99 (0.65)
Observations		9,906			9,874			9,891	
R squared	0.24	0.24	0.24	0.09	0.09	0.09	0.06	0.06	0.06

* p-value <0.10, ** p-value < 0.05, *** p-value <0.01

Table 9: Early childcare and child outcomes (age 7)

	Pattern construction			Word reading			Number skills		
	Any	Hours	Main	Any	Hours	Main	Any	Hours	Main
No arrangements	0.49 (0.45)		-0.16 (0.40)	-0.52 (0.71)		0.27 (0.64)	0.05 (0.11)		-0.16 (0.10)
Parents	0.39 (0.41)	-0.01 (0.01)	-0.51 (0.44)	-0.67 (0.63)	0.01 (0.02)	0.02 (0.68)	0.08 (0.10)	0.00 (0.00)	-0.15 (0.11)
Grandparents	0.48 (0.41)	0.00 (0.01)	-0.22 (0.40)	-0.65 (0.65)	0.01 (0.02)	0.28 (0.63)	0.10 (0.10)	-0.00 (0.00)	-0.14 (0.10)
Formal care	0.50 (0.45)	0.01 (0.01)		-0.79 (0.70)	-0.01 (0.02)		0.19* (0.11)	0.00 (0.00)	
Child-minder	0.32 (0.53)	-0.01 (0.02)	-0.36 (0.52)	-0.34 (0.81)	0.01 (0.02)	0.41 (0.80)	0.06 (0.13)	-0.00 (0.00)	-0.15 (0.13)
Others	0.17 (0.57)	-0.02 (0.02)	-0.16 (0.64)	-1.04 (0.92)	-0.03 (0.04)	-0.07 (1.04)	0.06 (0.14)	-0.00 (0.01)	-0.08 (0.16)
Observations		9,817			9,729			9,857	
R squared	0.10	0.10	0.10	0.15	0.15	0.15	0.11	0.11	0.11

* p-value <0.10, ** p-value < 0.05, *** p-value <0.01

Table 10: Heterogeneous effects of early childcare

PANEL A (age 3)						
	School readiness		Naming vocabulary			
	Below	Above	Below	Above		
No arrangements	-2.54** (1.01)	-0.16 (0.75)	0.01 (0.67)	1.29** (0.52)		
Parents	-2.75** (1.19)	-0.52 (0.76)	-0.11 (0.81)	1.85*** (0.52)		
Grandparents	-2.64** (1.13)	-0.75 (0.67)	-0.29 (0.75)	1.96*** (0.47)		
Child-minder	-1.46 (1.51)	-1.35 (0.84)	0.70 (1.02)	0.66 (0.56)		
Others	-4.09*** (1.58)	-0.60 (1.15)	-0.37 (0.99)	0.36 (0.80)		
Observations	4,151	4,292	4,331	4,482		
R squared	0.19	0.14	0.24	0.12		
PANEL B (age 5)						
	Naming vocabulary		Pattern construction		Picture similarity	
	Below	Above	Below	Above	Below	Above
No arrangements	-1.49** (0.64)	-0.02 (0.51)	-1.05 (0.70)	0.43 (0.48)	-1.31* (0.70)	-0.87* (0.51)
Parents	-1.74** (0.76)	0.43 (0.49)	-1.58** (0.78)	-0.40 (0.49)	-1.93** (0.80)	-1.32*** (0.51)
Grandparents	-1.00 (0.73)	0.29 (0.44)	-1.62** (0.76)	0.22 (0.43)	-1.53** (0.77)	-1.30*** (0.46)
Child-minder	0.16 (1.07)	0.31 (0.55)	-0.81 (1.02)	0.29 (0.56)	-1.53 (1.06)	-0.99* (0.59)
Others	-1.90* (1.00)	-1.58** (0.79)	-0.53 (1.04)	-1.32 (0.88)	-0.45 (1.08)	-2.50*** (0.87)
Observations	4,560	4,613	4,541	4,602	4,553	4,605
R squared	0.22	0.12	0.09	0.07	0.06	0.05
PANEL C (age 7)						
	Pattern construction		Word reading		Number skills	
	Below	Above	Below	Above	Below	Above
No arrangements	-1.80** (0.71)	0.79 (0.54)	-0.19 (1.20)	0.08 (0.82)	-0.53*** (0.19)	-0.06 (0.13)
Parents	-1.66** (0.82)	-0.38 (0.55)	-0.87 (1.37)	0.38 (0.83)	-0.56*** (0.21)	-0.17 (0.13)
Grandparents	-1.71** (0.81)	0.08 (0.49)	-0.44 (1.33)	0.46 (0.75)	-0.50** (0.21)	-0.13 (0.12)
Child-minder	-0.96 (1.13)	-0.55 (0.61)	-1.48 (1.81)	0.31 (0.92)	-0.68** (0.29)	-0.09 (0.14)
Others	-1.10 (1.08)	-1.02 (0.87)	-3.26* (1.85)	1.00 (1.33)	-0.38 (0.30)	-0.23 (0.19)
Observations	4,502	4,587	4,466	4,546	4,526	4,602
R squared	0.08	0.07	0.13	0.11	0.08	0.08

Notes: effect of main care on child outcomes (formal care is the excluded category). “Below” indicates the sub-sample of children with income lower than the median income; “Above” indicates the sub-sample of children with income higher than the median income.

* p-value <0.10, ** p-value < 0.05, *** p-value <0.01

Table 11: Change of childcare arrangements over time (age 3)

	School readiness			Naming vocabulary		
	Average effects	Heterogeneous effects		Average effects	Heterogeneous effects	
	Any	Below	Above	Any	Below	Above
Parents	-2.58*** (0.96)	-2.34* (1.34)	-2.74* (1.43)	-0.68 (0.69)	0.03 (0.93)	-1.20 (1.05)
Grandparents	0.71 (0.78)	1.61 (1.15)	-0.53 (1.13)	0.68 (0.55)	0.84 (0.81)	0.62 (0.79)
Formal care	1.37*** (0.50)	2.16*** (0.83)	0.17 (0.64)	-0.54 (0.34)	-0.12 (0.54)	-1.09** (0.45)
Child-minder	-1.44 (0.96)	-0.58 (1.54)	-1.88 (1.30)	-1.21* (0.63)	-1.05 (1.05)	-1.01 (0.81)
Others	1.00 (0.89)	0.49 (1.31)	0.80 (1.22)	-0.02 (0.63)	0.31 (0.93)	-0.33 (0.95)
Observations	9,088	4,151	4,292	9,498	4,331	4,482

Notes: effect of introducing a new type of childcare between age 9 months and age 3 years (reference category: never experienced that type of childcare between age 9 months and age 3 years). "Below" indicates the sub-sample of children with income lower than the median income; "Above" indicates the sub-sample of children with income higher than the median income.

* p-value <0.10, ** p-value < 0.05, *** p-value <0.01

Table 12: Fixed-effects model (Naming vocabulary, age 3 and 5)

	Average effects	Heterogeneous effects	
	Any	Below	Above
Formal care	-0.88*** (0.29)	-0.20 (0.41)	-1.53*** (0.46)
Child-minder	-0.22 (0.50)	-0.87 (0.89)	0.33 (0.64)
Observations	11,664	6,128	4,676

Notes: sample of children looked after in the family (no arrangements, parents, grandparents) when they were 3 years old, who may have started being cared in formal care or by a child-minder between 3 and 5. Linear fixed effect model. "Below" indicates the sub-sample of children with income lower than the median income; "Above" indicates the sub-sample of children with income higher than the median income. * p-value <0.10, ** p-value < 0.05, *** p-value <0.01

Table 13: Percentage of people who agree with the following statements, by distance to grandparents

Opinions	Mothers living close to grandparents	Mothers living far from grandparents	Sign. diff.
2001			
Pre-school child suffers if mother works	24.5	25.3	
Family suffers if woman works full time	30.4	31.6	
Children need father as much as mother	83.1	83.9	
Employers should help with childcare	85.9	88.2	
Single parents are as good as couples	59.6	66.3	**
<i>Observations</i>	494	352	
2002, 2006			
Parents ought stay together for children	5.4	7.5	
Marital status is irrelevant to children	56.8	50.9	
<i>Observations</i>	903	898	

Notes: sample of women 2 years before/after the birth of a child.
Source: BHPS 2001, 2002, 2006

Table 14: Descriptive statistics of moving choices, new mother and all other women

	Mothers	All other women
Non-movers	82.2	87.2
Movers	17.8	12.8
Observations	12,240	44,523
Reason for moving		
Job related	8.7	15.4
Partner related	14.0	16.3
Move in with family	1.2	1.8
Move from with family	1.1	1.2
To be closer to family, friends	3.2	2.4
Friends or college related	0.7	7.3
Forced moving	5.8	6.8
Accommodation or area reasons	56.7	41.3
Others	8.6	7.5
Observations	1,969	5,130

Notes: women 2 years before/after the birth of a child versus all women

Source: BHPS 1991-2008

Table 15: IV estimations (Grandparents versus formal care)

	OLS	IV	Kleibergen-Paap rk LM statistic	Observations
	Grandparents (Main)	Grandparents (Main)		
Age 3				
School readiness	-1.23** (0.60)	-2.13 (2.19)	184 (0.000)	2,756
Naming vocabulary	1.37*** (0.40)	1.99 (1.47)	189 (0.000)	2,868
Age 5				
Naming vocabulary	-0.15 (0.39)	-1.12 (1.44)	187 (0.000)	2,946
Pattern construction	-0.47 (0.38)	0.42 (1.38)	188 (0.000)	2,938
Picture similarity	-1.26*** (0.41)	-3.55** (1.50)	187 (0.000)	2,942
Age 7				
Pattern construction	-0.32 (0.43)	-0.20 (1.55)	197 (0.000)	2,929
Word reading	-0.15 (0.68)	-0.53 (2.40)	194 (0.000)	2,886
Number skills	-0.22** (0.11)	-0.46 (0.38)	198 (0.000)	2,935

Notes: effect of grandparents care as main care when the child is 18 months old (excluded category: formal care). OLS and IV estimations (excluded instruments: living 15 minutes far away from grandparents, 15-30 minutes, 30-60 minutes). * p-value < 0.10, ** p-value < 0.05, *** p-value < 0.01

Table 16: IV estimations (Grandparents versus formal care) – Heterogeneous effects

		OLS	IV	Kleibergen- Paap rk LM statistic	Observations
		Grandparents	Grandparents		
Age 3					
School readiness	Below	-2.10* (1.25)	-10.38* (6.23)	26 (0.000)	807
	Above	-1.13 (0.71)	0.30 (2.43)	145 (0.000)	1,794
Naming vocabulary	Below	0.09 (0.81)	0.20 (3.86)	27 (0.000)	831
	Above	1.83*** (0.50)	1.87 (1.65)	150 (0.000)	1,870
Age 5					
Naming vocabulary	Below	-1.06 (0.79)	-2.63 (3.97)	27 (0.000)	861
	Above	0.17 (0.47)	-0.66 (1.58)	145 (0.000)	1,909
Pattern construction	Below	-1.87** (0.87)	2.00 (4.03)	26 (0.000)	857
	Above	0.09 (0.44)	0.98 (1.51)	146 (0.000)	1,906
Picture similarity	Below	-1.98** (0.84)	-5.49 (4.13)	27 (0.000)	860
	Above	-1.18** (0.50)	-3.49** (1.67)	145 (0.000)	1,905
Age 7					
Pattern construction	Below	-1.58* (0.86)	4.93 (3.89)	31 (0.000)	854
	Above	0.08 (0.51)	-0.85 (1.80)	147 (0.000)	1,901
Word reading	Below	-1.09 (1.41)	-13.40** (6.50)	32 (0.000)	836
	Above	0.34 (0.81)	3.23 (2.70)	143 (0.000)	1,878
Number skills	Below	-0.44* (0.23)	-2.62** (1.10)	31 (0.000)	856
	Above	-0.16 (0.12)	0.14 (0.41)	148 (0.000)	1,904

Notes: effect of grandparents care as main care when the child is 18 months old (excluded category: formal care). OLS and IV estimations (excluded instruments: living 15 minutes far away from grandparents, 15-30 minutes, 30-60 minutes). “Below” indicates the sub-sample of children with income lower than the median income; “Above” indicates the sub-sample of children with income higher than the median income. * p-value < 0.10, ** p-value < 0.05, *** p-value < 0.01

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Appendix

Table A1: *Childcare /educational decisions over time*

	Main results (Tables 8-9)	Controlling for formal care after 18 months old	Controlling for formal care after 18 months old and school at age 5
	Any	Any	Any
Naming vocabulary (age 5)			
Grandparents	0.75** (0.36)	0.74** (0.36)	
Child-minder	0.88* (0.48)	0.88* (0.48)	
Pattern construction (age 5)			
Mum at home	0.78** (0.40)	0.79** (0.40)	
Child-minder	0.84* (0.47)	0.84* (0.47)	
Picture similarity (age 5)			
Formal care	1.28*** (0.43)	1.21*** (0.43)	
Number skills (age 7)			
Formal care	0.19* (0.11)		0.18* (0.11)

Notes: significant coefficients from Tables 8-9 (first column), adding controls for subsequent childcare / educational education. * p-value <0.10, ** p-value < 0.05, *** p-value <0.01

Table A2: *Early childcare in different points in time*

	Main results Childcare 18 months old (Tables 7-9)	Childcare 12 months old	Childcare 24 months old
	Any	Any	Any
School readiness (age 3)			
Formal care	1.69*** (0.61)	1.73*** (0.66)	1.76*** (0.53)
Naming vocabulary (age 3)			
Parents	0.84** (0.39)	1.08*** (0.40)	0.79** (0.37)
Grandparents	1.25*** (0.39)	1.45*** (0.39)	1.43*** (0.36)
Naming vocabulary (age 5)			
Grandparents	0.75** (0.36)	0.78** (0.37)	0.84** (0.34)
Child-minder	0.88* (0.48)	0.65 (0.49)	0.66 (0.46)
Pattern construction (age 5)			
Mum at home	0.78** (0.40)	0.46 (0.42)	0.70* (0.37)
Child-minder	0.84* (0.47)	0.52 (0.49)	0.82* (0.44)
Picture similarity (age 5)			
Formal care	1.28*** (0.43)	1.22*** (0.46)	0.48 (0.66)
Number skills (age 7)			
Formal care	0.19* (0.11)	0.11 (0.12)	0.13 (0.10)

Notes: significant coefficients from Tables 7-9 (first column), substituting childcare choices at 18 months old with childcare at 12 and 24 months old. * p-value <0.10, ** p-value < 0.05, *** p-value <0.01