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The Relation Between Maternal Work Hours and the Cognitive Development of Young School-Aged Children

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Abstract This paper analyses the relation between maternal work hours and the cognitive development of young school-going children. We find that children's language and sorting test scores are higher when their mothers have a large part-time job or even a full-time job. We find no evidence that this can be explained by a richer home environment in terms of the number of parent–child activities provided to the child.

Keywords Intergenerational human capital investments · (Non) cognitive skills · Maternal labour supply · Home environment

JEL Classification D10 · J13 · J22 · J24

1 Introduction

Several studies deal with the relation between maternal employment and child outcomes (e.g. Desai et al. 1989; Ermisch and Francesconi 2000; Harvey 1999; Vandell and Ramanan 1992). Although their results have not always pointed in the same direc-

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tion, most studies have found a negative relation between early maternal employment and child outcomes (e.g. Ruhm 2004; Baum 2003; Ermisch and Francesconi 2000). However, most studies have concentrated on maternal work status before children go to school.

In addition, public policies related to parental leave schemes focus on preschool-aged children. Therefore, most mothers with preschool-aged children do not participate in the labour market or choose to work part-time. In most European countries, mothers' labour market participation rate increases when children enter school, but the average number of working hours remains the same (LFS 2005). In the Netherlands, where labour market participation among mothers of preschool-aged children is high (75 %) but the number of working hours is low (20 h per week, on average), neither the extensive nor the intensive margins increase when children reach school age; that is, mothers of children aged four to six also work an average of 20 h. Several studies have shown that this is due to the preference of mothers to combine work with child care (e.g. Fouarge and Muffels 2008). When working part-time, mothers can take care of their children themselves outside school hours. Even though we observe that mothers of (young) school-aged children tend to work part-time, research on the relation between the part-time work status of mothers while children attend school and the cognitive outcomes of young children is sparse.

This paper analyses the relation between maternal work hours at age 4–5 and the cognitive development of young school-going children. The data set we use contains information on Dutch children in their first two years of regular primary school. Although the mandatory school age is five, the large majority of children enter school at the age of four. The data build on two sources: administrative data on language and sorting test scores from schools and a parental questionnaire with information on parental, child (including personality traits), and family characteristics.

There are several advantages to using Dutch data in this context. First, in their first two years in school, children are tested on their language and sorting skills via validated national tests from Cito, the official national testing institute in the Netherlands, to determine potential cognitive problems at an early stage. These test scores are available to us. These first two years are comparable to kindergarten but, unlike kindergarten, they are compulsory. Children learn to recognize letters and numbers in a setting that prioritizes playing and social interactions, but classes in reading, writing, or arithmetic are only offered from the third school year on. Therefore, the test scores reflect children's initial abilities and parental influences, as well as basic inputs from schools.[1] Second, since participation in these preparatory school years is obligatory, mothers do not have to choose between taking care of children and labour market participation, as is the case when their children are of preschool age. Because of the availability of part-time jobs in the Netherlands, mothers can match their work hours to school hours. Maternal employment, especially part-time employment, is therefore not necessarily related to lower time investments in children. Moreover, working may benefit children through greater family income (e.g. Dahl and Lochner 2012; Loken et al. 2012; Aughinbaugh and Gittleman 2003; Blau 1999). Family income can be used

[1] In our empirical analyses, differences in school inputs are accounted for by the inclusion of school fixed effects, making it more likely that test scores reflect initial abilities and parental inputs.

for both good nutrition and a rich home environment that stimulates child development (e.g. Fox et al. 2013). Part-time work can therefore have the advantage of allowing mothers to work during school hours and at the same time contribute to family income. Our data set does not include a direct measure of parental time spent with children or family income. However, our model includes measures of the richness of the home environment, as well as of the parents' education and labour supply.

We estimate a value-added model of the production of cognition in which we regress children's second year's test scores on maternal work hours, their first year's score, and other control variables. Two potential issues raised with respect to the value-added model are the potential endogeneity between ability and past achievement and omitted inputs (Todd and Wolpin 2003). As explained later, we deal with this by including direct measures of children's non-cognitive skills, which have been shown to relate to cognition and other important socioeconomic outcomes (Almlund et al. 2011; Borghans et al. 2008), and measures of the richness of the home environment, based on extensive lists of the daily and planned activities parents undertake with their children. The model includes school fixed effects to account for differences in didactic approaches between schools and teachers that could impact children's test scores. We find that both types of test scores are significantly related to maternal work hours. Whereas children's language test scores are highest when their mothers work between 12 and 32 h per week, their sorting test scores are highest when their mothers work at least 12 h per week. We do not find any evidence that a rich home environment plays a role in explaining this relation between maternal employment status and cognitive child development.

The structure of this paper is as follows: The next section describes the related literature. In Sect. 3 we describe the value-added model and our empirical specification in detail. Section 4 describes the data and presents descriptive statistics. Section 5 reports the results. Finally, Section 6 concludes the paper.

2 Related Literature

In their seminal paper, Todd and Wolpin (2007) investigated the theory and empirical implications of the production of cognition in children, focusing specifically on family inputs and school inputs. They concluded that a value-added model best fits the notion that a child's cognitive development is a cumulative process that builds on its own endowments and inputs from family and school. We build on this framework in Sect. 3. Although Todd and Wolpin (2007) do not explicitly deal with the relation between maternal employment and child outcomes, there is an extensive literature that does.[2] That literature questions whether children profit more from a non-working mother who takes care of her child herself or from a mother who works, thereby contributing to family income, but sends her child—at least for some days per week—to formal or informal child care. The effect of maternal employment on child outcomes for preschool-aged children can therefore be split into a time effect (e.g.

[2] See Goldberg et al. (2008) for an extensive overview and meta-analyses of this stream of literature.

Bettinger et al. 2014) and an income effect (e.g. Dahl and Lochner 2012; Loken et al. 2012).[3]

Studies focusing on early maternal employment have mainly found a negative effect of working on child outcomes. Bernal (2008), for example, used US data to estimate a dynamic model and showed that a mother working full-time during the child's first year after birth is associated with a reduction of 1.8 % in the child's ability test scores for ages three to six years. In addition, Baum (2003) found that maternal paid work in a child's first year has detrimental effects on the child's cognitive development. The author also found that working during the first quarter after childbirth decreases child outcomes (as measured by the Peabody Picture Vocabulary Test). Moreover, the author's results suggested that increased family income from maternal work partially offsets the negative effects of maternal employment. Ruhm (2004) showed that maternal employment during the first three years of a child's life has a negative effect on the cognitive abilities of children aged five and six years. The effects found are greater for reading and mathematics than for verbal abilities. Evidence shows more favourable outcomes when mothers work part-time than when they work full-time when the child is two or three years old. Using the British Household Panel Study, Ermisch and Francesconi (2000) found a negative effect of mothers' full-time employment when the child is zero to five years old on the child's educational attainment as a young adult. The effect of mothers' part-time employment status is also negative, but smaller and insignificant. Similarly, the effect of fathers' employment is small and negative but not always significant. Vandell and Ramanan (1992) showed that early maternal employment has a positive effect on reading and math scores for disadvantaged children.

Ruhm (2004) suggested that the labour supply decision of parents seems to involve a trade-off between time and goods investments in preschool-aged children. The literature does not find a consistent relation between parental working hours and time investments. Bianchi (2000) showed that mothers with paid employment spend, on average, nearly as many hours in direct child interactions as non-employed mothers do. However, other studies have found that working parents spend less time with their children than non-working parents do. For example, Fox et al. (2013) found that employed mothers spend significantly less time carrying out primary child care than their non-employed counterparts do. Cawley and Liu (2007) analysed whether working mothers spend less time on specific parent–child activities than non-working mothers and found that employed women spend significantly less time reading to their children, helping with their homework, and in educational activities in general.

There is also literature showing that parental work hours may affect child outcomes through family income and, thereby, through good nutrition and a home environment that focuses on child development (e.g. Dahl and Lochner 2012; Loken et al. 2012; Aughinbaugh and Gittleman 2003; Blau 1999). For example, Fox et al. (2013) found

[3] It is important to distinguish between children from one- and two-parent families, since children from single mothers might benefit from maternal employment and the related increased income and children in two-parent families might experience adverse maternal employment effects if the mother is absent from the home (Lucas-Thompson et al. 2010). On the other hand, the mother's absence due to employment might have greater consequences for parent–child activities in one-parent families than in two-parent families.

that the increase in market work during the last centuries has been accompanied by a rise in family income in the typical US two-parent family. Moreover, Kornrich and Furstenberg (2013) found a gap in child expenditures between rich and poor parents. Ruhm (2008) analysed more precisely whether home environment is the driving force in the relation between early maternal employment and later child outcomes (ages 10 to 11). The author included a variable measuring the home environment that consists of a mix of observational and parent-reported items assessing the emotional support and cognitive stimulation received by children through their home environment, planned events, and family surroundings. Ruhm (2008) found that a better home environment benefits child outcomes. The negative though not always significant signs of the interaction terms with maternal work hours suggest that this positive effect of home environment is smaller when mothers work more hours.

This overview shows that nearly all studies focus on early maternal employment. This implies that parents have to choose between time in the labour market and time with their children. In the Netherlands, children have to attend school from the age of four and, because part-time jobs are widely available, mothers are able to work while their children go to school. The maternal deprivation perspective (Gottfried and Gottfried 2006), in which maternal employment is seen as a form of maternal absence and, hence, the child is considered to be deprived of being with the mother while she is at work, therefore does not hold in this setting. This implies that the relation between maternal work hours and child outcomes is expected to be different in this paper.

3 Empirical Strategy

Building on the literature, we view child development as a cumulative process in which a child's cognition is a function of current inputs, past inputs, and abilities. Because past inputs and abilities are unobserved, we estimate a value-added model of the production of cognition in children by including lagged achievement measures of cognition.

In this model, current test scores are regressed on current family inputs and a lagged measure of cognitive achievement to capture the effects of past inputs and a child's abilities. The model is as follows:

$$C_{ihsk,t=1} = \alpha_k + \beta_k L_{ihsk,t=1} + \lambda_k C_{ihsk,t=0} + \gamma_k X_{ihs,t=1} + \epsilon_{ihsk,t=1} \quad (1)$$

where $C_{ihsk,t}$ is the test score from child i in household h in school s of test k at time t, $L_{ihsk,t=1}$ is a matrix of variables capturing parental working hours, and $X_{ihsk,t=1}$ is the vector denoting control variables. All input and control variables are measured at time $t = 1$. The variable $C_{ihsk,t=0}$ denotes the lagged test score. As Todd and Wolpin (2007), we assume that the error term contains four additive components:

$$\epsilon_{ihsk,t=1} = \varepsilon_i + \varepsilon_h + \varepsilon_s + \zeta_{ihsk,t=1} \quad (2)$$

where ε_i, ε_h, and ε_s denote child, family, and school fixed effects, respectively, and $\zeta_{ihsk,t=1}$ denotes the idiosyncratic error.

The model we estimate is as follows:

$$\begin{aligned} C_{ihsk,t=1} = \alpha'_k + \beta'_{k1} SPTm_{i,t=1} + \beta'_{k2} LPT_{i,t=1} + \beta'_{k3} FTm_{i,t=1} \\ + \gamma'_{k1} NWf_{i,t=1} + \gamma'_{k2} PTf_{i,t=1} + \eta'_k C_{ihsk,t=0} + \delta'_k X_{ihs,t=1} \\ + \lambda'_k NC_{i,t=1} + \theta'_k HE_{h,t=1} + \phi'_k PS_{h,t=1} + \varepsilon'_{s,t=1} + \zeta'_{ihsk,t=1} \end{aligned} \quad (3)$$

where SPT_i, LPT_i, and FTm_i are dummy variables that denote whether the mother has a small part-time job, a large part-time job, or a full-time job, respectively.[4] The reference group consists of mothers without a paid job. For fathers, we include two dummy variables denoting deviation from full-time employment, which is the most common work status: a dummy for having no paid employment (NWf_i) and another for having a part-time job (PTf_i).[5]

While this is an arguably more convincing approach than using a contemporaneous specification that relates current inputs to current outcomes (Hanushek 2003), the value-added model has also received criticism (Todd and Wolpin 2003). Three key assumptions of the model have been challenged: that the effect of past inputs does not vary by age, that the effect of past inputs declines geometrically with age, and that the effect of ability on current outcomes also declines with age at the same rate as past input effects. These assumptions are indeed source of concern for studies that focus on a heterogeneous sample of children that varies in age and time span between the measurements of lagged and current achievement. In our particular case, these concerns are less likely to apply, since we focus on a homogeneous group of children for which the cognitive outcomes are measured at around age five, while lagged cognition is measured one year earlier.

A fourth potential issue raised with respect to the value-added model is the potential endogeneity between ability and past achievement (Todd and Wolpin 2003). Resolving this issue would require at least three measures of individual outcomes or the use of siblings' test scores (Nicoletti and Rabe 2012), but such data are not available to us.[6] However, the data set at hand is very elaborate in terms of child's characteristics. We use direct measures of children's non-cognitive skills and behavioural characteristics (**NC**) that have been shown to relate to cognition (ε_i) and other important socioeconomic outcomes (Almlund et al. 2011; Borghans et al. 2008). Controlling for non-cognitive skills and behavioural characteristics will largely take care of the normally unobserved heterogeneity across children.

A last potential weakness of the value-added model, according to Todd and Wolpin (2003), pertains to omitted variables, for example, unmeasured parental inputs. To reduce unobserved heterogeneity across households (ε_h), we include the number of joint daily and planned activities parents undertake with their children as measures of the richness of the home environment (HE_h), that is, the extent to which a child

[4] The construction of these and the other variables included in model (3) is explained in detail in Sect. 4.

[5] In a robustness check, we perform our analyses for a subsample of children of full-time working fathers.

[6] Whereas we have two observations for test scores, we have only one observation for the input variables. Since we have school information on children attending the first and second years of compulsory kindergarten, we cannot use sibling fixed effects either.

has access to a large variety of home inputs.[7] We also include measures of parenting styles PS_h (parenting goals and parental views). So, even without panel data, we are able to reduce unobserved heterogeneity with respect to both child and household characteristics to a large extent.[8] To investigate whether the relation between maternal work status and the cognitive development of children is affected by the richness of the home environment, we report regression results without and with the two variables measuring parent–child activities.

4 Data and Descriptive Statistics

4.1 Dutch Early School System

In the Netherlands, parents are free to choose a primary school for their children. Attending school is obligatory from the age of five on. However, 98 % of all children enter primary school at the age of four (CBS 2003). During the first two school years, children have to go to school for about 900 h per year, which is about 30 h per week.[9] The first two years of primary school in the Netherlands are comparable to kindergarten, although compulsory from the age of five. At this age, children are being prepared for the learning activities they will have from the third school year onwards, but there is a strong emphasis on play and the development of social skills. Only from the third school year on do children have classes in reading, writing, and arithmetic.

Nevertheless, in most schools, children are tested on their language and sorting skills halfway through the first and second school years. These tests are developed and validated by the national testing institute Cito to determine possible cognitive problems at an early age. Although schools are not obliged to test children, about 62 % of all schools test their pupils in the first school year, with this percentage increasing to 76 % in the second school year (Jungbluth and Rodigas 2011).

[7] Our focus is on the richness of a child's environment in terms of the quantity of joint activities provided. Of course, the quality of the home environment provided is important as well.

[8] Unfortunately, our data are cross-sectional, with the exception that test scores are measured in two successive years. Therefore, our estimations do not warrant a causal interpretation. However, since the children in our data were very young and had not yet started learning how to read, write, or do arithmetic at school, it is likely that both parental work hours and the number of joint parent–child activities are exogenous with respect to child outcomes, because at preschool ages the child endowments we analyse are not revealed to parents (Ermisch and Francesconi 2000; Rosenzweig and Wolpin 1995). Due to the unique control variables included in the estimations, such as non-cognitive skills, parental views, and parenting goals, unobserved heterogeneity and the associated likelihood of spurious effects are not likely to be a serious issue. There might be another source of endogeneity as well: Parents who are less productive in raising their children could also be less productive in the labour market. This could lead to an upward bias in our findings. However, since we include parental education in the analyses to control for this potential source of unobserved heterogeneity, the bias is likely to be small. Nevertheless, our findings should not be interpreted causally.

[9] By law, schools must provide at least 880 h and at most 940 h of education per year. Most children have Wednesday afternoon off, but schools are free to institute their own schedules (see http://www.rijksoverheid.nl/onderwerpen/schooltijden-en-onderwijstijd).

4.2 Moelejaan Data

This paper uses the Moelejaan data from the research institute KAANS at Maastricht University. The Moelejaan project focuses on preschool and early-school education in the southern part of the Dutch province of Limburg.[10] The data set builds on two sources: test scores provided by schools and survey information from parents.

4.2.1 Information from Schools

Test scores were provided by schools. Children were tested twice, halfway through the first and second school years, by which time 98 % of the children were aged four to five. The children were tested on their sorting and language skills. We have information on these tests from two cohorts of children: Cohorts 1 and 2 took the tests in the first school year around January 2007 and January 2008, respectively, and in the second school year around January 2008 and January 2009, respectively.[11]

4.2.2 Parental Questionnaire

All parents of children attending the first two school years of all primary schools in southern Limburg received a questionnaire via the school in September 2008.[12] Parents could return the questionnaire to the school in a sealed envelope. The survey contained information on parental work time, as well as information on the activities they undertook with their child. Moreover, it included detailed questions on the child (e.g. various behaviour characteristics and non-cognitive skills), the parents (e.g. educational level, parental views, and parenting goals), and the household (e.g. the number of children and the presence of other adults).

About 60 % of all children attending the second year of primary school were tested in both the first and second school years. Although the response rate of the parental questionnaire was almost 70 %, only 45 % of the parents completed the full survey. We focus on two-parent families, since recent studies suggest that the relation between maternal employment and child outcomes differs between one- and two-parent families (e.g. Goldberg et al. 2008; Lucas-Thompson et al. 2010).[13] However, because our analyses include school fixed effects, we only include children for whom we also have information on at least 10 other pupils at the same school. This leaves us with

[10] Although the industrial structure of the southern part of Limburg differs in some aspects from the rest of the Netherlands (e.g. a larger share of the employed work in the chemical sector and a lower share works in the food industry), the share of women in the labour force is similar (45 %), as is the number of working hours (34, on average, per week).

[11] There are some exceptions: 2 % of the children attended the first year of primary school twice. For these children, we use their first test scores to make sure the test scores are comparable to those children who did not attend the first year of school twice. The age of children at the time they perform the tests is included in the analyses to take into account their age when entering school. If we exclude those attending the first year of primary school twice, our results remain the same.

[12] One questionnaire was sent per child, with the child's name, address, date of birth, and gender at the top.

[13] This could also include step-parents and parent's partners.

Table 1 Summary statistics of raw test scores year 2

	Language test (year 2)			Sorting test (year 2)		
	Mean	SE	N	Mean	SE	N
No job	46.1	6.1	328	32.4	4.8	275
Small part-time	46.9	5.3	95	33.4	4.6	70
Large part-time	47.8	5.2	1,274	34.1	4.5	1,084
Full-time	47.2	5.2	292	33.6	4.4	247
Total	47.4	5.4	1,989	33.7	4.6	1,676

This table reports the number of good answers in the language and sorting test. The total number of questions in the language test equals 56, the total number of questions in the sorting test equals 42

a sample of 2,060 children.[14] Since some children only completed one type of test, our sample sizes for the analyses on child outcomes differ. Our sample for the language test includes 1,989 children, whereas that for the sorting test includes 1,676 children.[15]

4.3 Main Variables of Interest

4.3.1 Human Capital Outcomes

We use two test scores for children's cognitive skills (C_{ihsk}): language ($k = 1$) and sorting ($k = 2$). During the tests, the children worked in their own assignment books. The teacher read the assignment out loud and the children had to mark what they believed was the correct answer. The tests consisted of two parts, both taking about 20–30 min. The tests were similar in the first and second years and for both cohorts of children. The test scores are the number of good answers.

The language test deals with passive vocabulary and critical listening and involves 56 assignments. The sorting test involves 42 assignments that focus on three sorting principles: classifying subjects (placing them next to each other), ranking subjects, and comparing and counting them.

Table 1 reports the raw test scores in children's second year of school. On average, the children got 47 out of 56 questions right on the language test. With respect to the sorting test, the children got, on average, about 34 out of 42 questions right.[16] Table 1 shows that the mean test scores of the children of mothers without a job are lower than those of the children of mothers with a job. Based on the table, there is no clear continuous relation between test scores and mothers' work hours. In the analyses, the standardized test scores are used.

[14] This more restricted sample of children is representative of the larger sample in terms of both cognitive test scores, maternal employment, and control variables.

[15] The sample of children included seems to be slightly positively selected. The children in our sample scored, on average, one point higher per test compared to children whose parents did not complete the survey. For the distribution of test scores of the sample and the population, see Fig. 4 in Appendix 1.

[16] Group mean comparison tests show that girls performed significantly better in both tests than boys. This is a common finding in the literature.

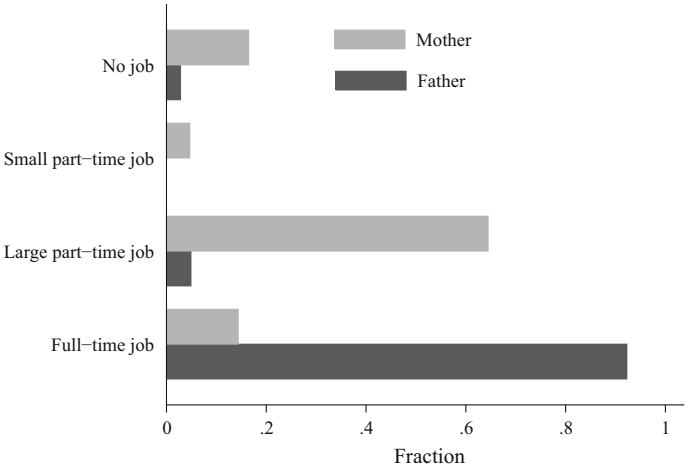

Fig. 1 Parental work status

4.3.2 Maternal Work Status

The questionnaire provides information on parental work time. Responding parents were asked to report whether they and their partners worked and, if so, how many hours a week, as followings: not working, working in a small part-time job ($SPTm_i$, fewer than 12 h a week), a large part-time job ($LPTm_i$, 12–32 h a week), or working in a full-time job (FTm_i, more than 32 h a week). Figure 1 reports the distribution of maternal and paternal work status. Most children (64 %) had a mother with a large part-time job, 15 % of the children had a mother who worked full-time, and 5 % had a mother with a small part-time job. The remaining 16 % of the children had a mother without a paid job. We use the latter as the reference category in the analyses. Since almost all fathers in the sample worked full-time, we control for paternal work status but do not focus on the role it plays on cognitive development of children. About 4.5 % of all fathers had a part-time job (PTf_i) and 3 % of the children had a father without a paid job (NWf_i). The distribution of parental work hours is identical for boys and girls.

4.4 Control Variables

We include measures for the non-cognitive skills and behavioural characteristics of the children (NC_i). Non-cognitive skills are measured in the parental questionnaire, which includes 42 items on the child's personality. Exploratory factor analysis shows that we can distinguish among four factors that relate to the following traits of personality: inquisitiveness (e.g. 'my child is interested'), individualism (e.g. 'my child is independent'), difficulty (e.g. 'my child is bothersome'), and sociability (e.g. 'my child is oriented toward other children'). The standardized values of these factors are included in all estimations on the cognitive development of children.[17] Moreover, we include a vector with dummy variables indicating whether the child suffers from

[17] The factor loadings for this factor analysis and the upcoming ones are shown in Tables 6–8 in Appendix 1.

difficulties with respect to emotions, concentration, behaviour, and relationships with other people, as reported in the parents' questionnaire.

The richness of the home environment (HE_h) is part of the model through the inclusion of two variables. We differentiate between parent–child activities that can be undertaken daily and activities that require planning.[18] Examples of joint daily activities (11 in total) are reading stories to your child and playing outside with your child. Examples of planned activities (seven in total) are going to a museum with your child and going to a swimming pool with your child. We construct a variable measuring the number of joint activities parents undertook with their child. We also include two variables related to parenting styles that may convey information on heterogeneity in parenting styles (PS_h): parental views on traditional gender divides and parenting goals related to their child's independence. Parents' views on traditional gender divides are measured by the extent to which they agreed with 16 statements (e.g. 'men do mostly a better job in managing occupations') on a five-point Likert scale. With respect to parenting goals related to their child's independence, parents were asked to state how they viewed the importance of 12 goals for their children (e.g. 'take time for her/himself') on a five-point Likert scale. The analyses include parental views on traditional gender divides and parenting goals related to their child's independence measured by two standardized factors constructed through factor analysis.

In the set of control variables (X_{ihs}), we include the following child characteristics: a gender dummy, a cohort dummy, a dummy for whether the child speaks Dutch with friends, a dummy for whether the parents speak Dutch to their child, and a variable denoting the child's religion. We also include a dummy variable indicating whether the child experienced a situation which potentially affects child development, such as the divorce of its parents.[19] Related to the child's parents, we include parental education levels (e.g. Carneiro et al. 2007). We distinguish between low, medium, and high education levels for mothers and fathers.[20] At the household level, we include the number of children living in the household and whether or not grandparents, uncles or aunts, or other adults are living in the household. Summary statistics of the control variables are reported in Table 9 in Appendix 1.[21]

In addition to this rich set of child, parent, and household characteristics, the data include school identifiers. Whereas we have information on the children of 125 schools, for some schools we have information on only a few children. We only include chil-

[18] For a full list of questions related to the home environment and the distribution of these variables (differentiated by maternal work status), see Appendix 2. It turns out that there is a positive significant correlation between maternal work hours and joint planned activities.

[19] Bertrand and Pan (2013) show the importance of such situations for child behaviour.

[20] In terms of the International Standard Classification of Education (ISCED): low (ISCED 0–2), intermediate (ISCED 3), and high (ISCED 5–7).

[21] We have no data on parental income. We do, however, have information on the number of children's books are available in the household. This is often used as a proxy for parental resources (e.g. Brunello and Checchi 2007). In our data set, this variable is not related to the human capital development of children and its inclusion therefore does not affect our results. Although we have no information on family income, the variables age, work hours, and education level together proxy for differences in family income due to work.

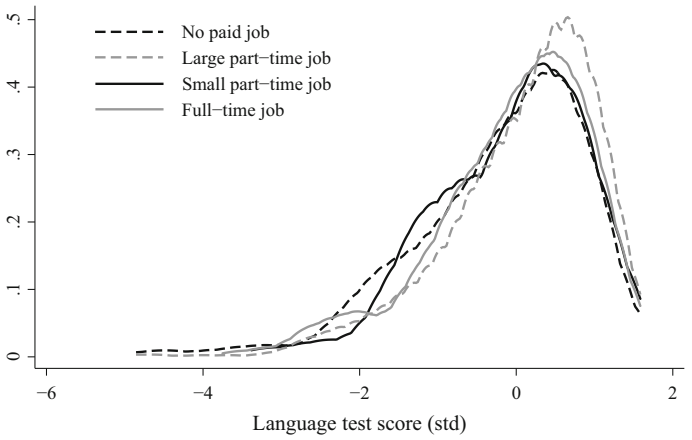

Fig. 2 Distribution of language test score by maternal work status

dren from schools for which we have more than 10 children in the sample.[22] In our main analyses, we include school fixed effects to control for differences in school performance and school environment. Because the average distance between home and school for children attending primary school in Limburg is relatively small (0.7 km),[23] these school fixed effects also capture neighbourhood effects, which have been shown to be a source of inequality in child achievement (Sastry and Pebley 2010).

5 Results

5.1 Descriptive Evidence

Figures 2 and 3 plot the distributions of the two test scores by maternal work status.[24] The language test score for children whose mothers work in large part-time jobs or full-time jobs are somewhat higher and display somewhat less dispersion than the test scores of other children (Fig. 2). The distribution of the sorting test score appears to be more clearly shifted to the right and more compressed when the mother has a large part-time job or a full-time job, compared to the sorting test score distributions of children with a mother with a small part-time job or without a paid job (Fig. 3). The next section analyses whether maternal work hours indeed matter for the cognitive development of children while controlling for, among other things, parental education.

[22] In an alternative specification, we estimate ordinary least squares (OLS) models including all children, which yields similar results. This is most probably due to the fact that the more restricted sample of children is representative of the larger sample.

[23] Source: CBS Statline, Regional information: Limburg: Years 2006, 2007, 2008.

[24] For the mean of the test scores by maternal work status, see Table 1.

Fig. 3 Distribution of sorting test score by maternal work status

5.2 Model Estimates

Table 2 reports the results of the school fixed effects model in Eq. (3).[25] The estimation results show that maternal work hours are related to the language development of children. Children whose mothers have a large part-time job perform best on the language test in their second school year. Moreover, the mother's educational level seems to be important for children's language test score. Since we control for children's test scores in the first year at school, this finding suggests that children from highly educated mothers experience larger increases in their human capital than those from less educated mothers. Conditional on the test score in the first year at school, children from a mother with a large part-time job, have about 12 % of a standard deviation more correct answers in the language test than children whose mother does not work (this is equivalent to 0.65 more correct answers). Thereby, the relation between the language test score and having a mother who works in a large part-time job is of comparable magnitude to a medium-educated mother.

The relation between maternal work hours and child development does not change after including joint parent–child activities in the regression.[26] Nevertheless, we find that the richness of the home environment as measured by the number of joint planned activities is positively related to children's language test scores, although this relation is only weakly significant.[27] The number of joint daily activities does not seem to be

[25] Since Figs. 2 and 3, show that the distribution of the test scores is truncated (most children perform well on the test), we performed Tobit fixed effects analyses to estimate the relation between maternal work status and the cognitive development of children. Since these Tobit estimates are similar to the OLS estimates (both with school fixed effects), we report the latter in this paper. Full results of the OLS school-fixed effects models are reported in Table 10 in Appendix 1.

[26] In Appendix 1, Table 10 reports all coefficients.

[27] The positive relation between joint planned activities and children's language test scores is driven by middle- and highly educated mothers. If we estimate the regressions separately for middle-/highly educated

Table 2 OLS results on the language test in the second school year

Dep. Var.: language test score year 2 (std)	(1) b/se	(2) b/se
Maternal employment status (ref: no job)		
Small part-time job	0.099	0.093
	(0.096)	(0.097)
Large part-time job	0.117**	0.115**
	(0.055)	(0.055)
Full-time job	0.102	0.101
	(0.068)	(0.068)
Maternal education level (ref: low educated)		
Medium educated	0.157***	0.148***
	(0.057)	(0.057)
High educated	0.235***	0.220***
	(0.067)	(0.067)
Home environment		
Daily parent-child activities		0.002
		(0.012)
Planned parent-child activities		0.035*
		(0.019)
First-year test score (std)	0.450***	0.447***
	(0.021)	(0.021)
Adj. R-squared	0.259	0.259
N	1989	1989

Both specifications include child, parent and household characteristics, as well as school fixed effects. Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

related to children's language test scores. This suggests that the number of joint daily activities does not matter for the cognitive development of children. Instead, the quality of joint daily activities or parent–child interaction might matter. To the extent that quality can be measured by parental education, the positive relation between maternal education and children's language test scores is in line with this idea. Moreover, the finding that children from mothers who have a large part-time job perform best in the language test in year two suggests that a combination of work and time available to spend with their children benefits children's language cognition.[28]

Table 3 shows the results from the analyses of the sorting test scores. The sorting test scores are also significantly related to maternal work hours. We find that children perform best in the sorting test when their mothers have a large part-time job or a full-time job.[29] Conditional on the test score in the first year at school, children from

and low-educated mothers, the positive significant relation between joint planned activities and children's language test scores is only found for children from middle-/highly educated parents.

[28] The observation that the coefficient for small part-time jobs is not significant might be caused by the small number of mothers with such a job.

[29] Even though the coefficient for mothers in large part-time jobs is only weakly significant in specification (1), it is not statistically different from that of mothers with a full-time job or from the coefficient for large part-time jobs in specification (2).

Table 3 OLS results on the sorting test in the second school year

Dep. Var.: Sorting test score year 2 (std)	(1) b/se	(2) b/se
Maternal employment status (ref: no job)		
Small part-time job	0.124	0.129
	(0.114)	(0.114)
Large part-time job	0.120*	0.121**
	(0.061)	(0.061)
Full-time job	0.175**	0.177**
	(0.077)	(0.077)
Maternal education level (ref: low educated)		
Medium educated	0.074	0.078
	(0.064)	(0.065)
High educated	0.029	0.031
	(0.075)	(0.076)
Home environment		
Daily parent-child activities		−0.007
		(0.014)
Planned parent-child activities		−0.008
		(0.021)
First-year test score (std)	0.449***	0.449***
	(0.024)	(0.024)
Adj. R-squared	0.236	0.236
N	1676	1676

Both specifications include child, parent and household characteristics, as well as school fixed effects. Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

a mother with a full-time job, have about 18 % of a standard deviation more correct answers in the sorting test than children whose mother does not work (this is equivalent to 0.83 more correct answers). The relation between cognitive outcome and having a mother who works full-time is of comparable magnitude (with opposite sign) as having experienced a potentially disruptive family situation. Moreover, it is comparable to having a father who is highly educated compared to low educated (see Table 10).

Table 3 also shows that joint parent–child activities are not significantly related to children's sorting test scores and that the relation between test scores and maternal work is unaffected by the inclusion of the number of joint parent–child activities.

Both the models related to children's language test score and the models related to children's sorting test score show that many of the control variables included to take child, parent and household heterogeneity into account are not significantly related to children's second year score once controlled for their first year test score. Apart from maternal work hours, exceptions are parental education, concentration problems and to some degree emotional problems and the experience of a situation that potentially affects child development (see Table 10 in Appendix 1). The first year test score thereby seems to capture much of the past inputs.

Overall, our findings show that cognitive development is higher for children whose mother works either part-time (12–32 h per week) or full-time (more than 32 h per

Table 4 Robustness results on the language test in the second school year

Dep. Var.: language test score year 2 (std)	Main model	Sample of only FT working fathers	Leaving out first year test score	Instrumented lagged test score
Maternal employment status (ref: no job)				
Small part-time job	0.093	0.065	0.087	0.236**
	(0.097)	(0.100)	(0.108)	(0.118)
Large part-time job	0.115**	0.109*	0.101	0.182***
	(0.055)	(0.057)	(0.061)	(0.064)
Full-time job	0.101	0.080	0.079	0.125
	(0.068)	(0.072)	(0.077)	(0.080)
Maternal education level (ref: low educated)				
Medium-educated	0.148***	0.112*	0.199***	0.103
	(0.057)	(0.059)	(0.063)	(0.068)
High-educated	0.220***	0.183***	0.295***	0.118
	(0.067)	(0.069)	(0.075)	(0.079)
Home environment				
Daily parent-child activities	0.002	0.008	−0.004	0.009
	(0.012)	(0.013)	(0.014)	(0.015)
Planned parent-child activities	0.035*	0.027	0.063***	0.009
	(0.019)	(0.020)	(0.021)	(0.022)
First-year test score (std)	0.447***	0.451***		0.817***
	(0.021)	(0.022)		(0.042)
Adj. R-squared	0.259	0.244	0.075	0.185
N	1989	1838	1989	1695

Both specifications include child, parent and household characteristics, as well as school fixed effects. Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

week).[30] We find no evidence of the richness of the home environment playing a large role in explaining children's test scores. Whereas the number of planned parent–child activities is, at least to some degree, related to children's language test scores, the number of daily parent–child activities is unrelated to either of the test scores. Therefore, it comes as no surprise that the richness of the home environment does not explain the positive relation between maternal employment and cognitive child development.[31]

5.3 Robustness Checks

We perform several robustness checks. The findings are reported in Tables 4 and 5. First, we perform the analyses on a subsample, children from full-time working fathers.

[30] We have found no heterogeneous effects of maternal employment with respect to either children's test scores, nor with respect to maternal education.

[31] We find no heterogeneous effects of our measures of home-environment with respect to maternal employment.

Table 5 Robustness results on the sorting test in the second school year

Dep. Var.: Sorting test score year 2 (std)	Main model	Sample of only FT working fathers	Leaving out first year test score	Instrumented lagged test score
Maternal employment status (ref: no job)				
Small part-time job	0.129	0.062	0.204	0.133
	(0.114)	(0.118)	(0.127)	(0.114)
Large part-time job	0.121**	0.090	0.183***	0.130**
	(0.061)	(0.064)	(0.068)	(0.062)
Full-time job	0.177**	0.153*	0.145*	0.201***
	(0.077)	(0.080)	(0.085)	(0.077)
Maternal education level (ref: low educated)				
Medium-educated	0.078	0.060	0.147**	0.064
	(0.065)	(0.067)	(0.072)	(0.064)
High-educated	0.031	0.043	0.162*	−0.004
	(0.076)	(0.078)	(0.084)	(0.076)
Home environment				
Daily parent-child activities	−0.007	−0.000	−0.004	−0.008
	(0.014)	(0.014)	(0.015)	(0.014)
Planned parent-child activities	−0.008	−0.003	0.016	−0.012
	(0.021)	(0.022)	(0.024)	(0.021)
First-year test score (std)	0.449***	0.450***		0.591***
	(0.024)	(0.024)		(0.040)
Adj. R-squared	0.236	0.224	0.055	0.273
N	1676	1546	1676	1648

Both specifications include child, parent and household characteristics, as well as school fixed effects. Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Since only 7 % of the children in our sample have a father who does not work full-time, we would like to see if our results are sensitive to the exclusion of the children with a father who does not work full-time. Tables 4 and 5 show that the point estimates of this robustness check are similar to those of the basic model. This indicates that the small group of children with a father working unusual hours does not impact upon our results. In a second robustness check, we leave out children's first-year test scores. This test score controls for past inputs and initial abilities. For the language test, we again find similar point estimates as in the main model, although the coefficient for mothers' large part-time job is no longer significant. Instead, the role of maternal education and planned parent-child activities increases. This confirms that the first year test scores reflect past inputs and initial abilities. For the sorting test, the point estimates and significance levels are unchanged. Nevertheless, also for the sorting test score, we observe that the coefficient relating maternal education to the second-year test becomes larger.

In our third robustness check, we test the sensitivity of our model to measurement error in the lagged test score. This measurement error might attenuate the coefficient

of the lagged test scores in value-added estimations and result in a bias of the input coefficients, such as maternal employment or the richness of the home environment. To account for this, we follow Andrabi et al. (2011) and instrument the lagged test score in one subject ($C_{ihsk=1,t=0}$) by the lagged test score in the alternate subject ($C_{ihsk=2,t=0}$). This approach is valid under the assumption that the measurement errors in both test scores are uncorrelated. In this specification, the lagged test score is larger, which suggests that there is measurement error in the test scores. For language test scores, we find that, contrary to our main model, children whose mother works in a small part-time job perform better compared to children whose mother does not work. The coefficient for children whose mother works in a full-time job is consistent with that in the main model.[32] Regarding the ordering test scores, we do not find that measurement error in test scores affects our results.

6 Conclusion and Discussion

In this paper, we analyse the relation between maternal work hours and the cognitive development of children. In contrast to most earlier research, our analyses focus on the work hours of mothers of young school-aged children. When children attend school, the potential time working mothers miss out spending with their children is much less than when children do not yet attend school. In particular, mothers who work part-time can work entirely during school hours. At the same time, working can benefit children, for example, through greater family income.

We estimate a value-added model of the production of cognition and find no negative relation between maternal employment and the cognitive development of children, as has often been found for maternal employment during preschool age. Instead, we find that children's language test scores are best when their mothers have a large part-time job, whereas sorting test scores are best when their mothers have a large part-time or full-time job. Our findings that part-time employment (12–32 h per week) seems to be best for children's cognitive development is probably related to the fact that the children in our sample all attend school for about 30 h a week.

We also show that maternal employment benefits children in a way that cannot be explained by a richer home environment in terms of the number of joint parent–child activities. We suggest two other mechanisms that could be driving our results. First, greater monetary resources might play a role in the relation found. In our sample, where almost all fathers work full-time, mothers' employment in large part-time or full-time jobs is likely to contribute to a higher family income. This additional income may benefit children through better nutrition and access to goods or services that are beneficial to their cognitive development. Several studies indeed show a positive although small effect of parental income on child development (e.g. Aughinbaugh and Gittleman 2003; Blau 1999). Brooks-Gunn et al. (2010) have shown that maternal employment is positively associated with mothers' earnings and that this offsets the

[32] The correlation between maternal education and language test scores disappears when we instrument the lagged language test score using lagged ordering scores. This is not surprising since the correlation between maternal education and the sorting test score in year two is fully captured by lagged ordering scores (see columns (1) and (3) in Table 5).

negative direct association between early maternal employment and child outcomes at age 4.5 in the United States.

Second, instead of the quantity, the quality of the home environment might explain why children from working mothers have higher cognitive skills. In this paper, we have performed several interaction models to see whether the role of home environment and/or maternal work status is heterogeneous across maternal education, but we did not find support for this idea. Nevertheless, the quality of home-environment might play a role in a way that we are not able to test this with the data at hand. At work, mothers may exchange information and experience regarding time allocation, good child care centres, and child-raising activities with their colleagues. So, whereas the variety of joint parent–child activities do not explain the relation between maternal work status and the cognitive development of children, the quality of parent–child interactions may be important. The quality of the parent–child activities of working mothers may also be higher, because mothers who work are happier and reflect this in their parenting. In particular, the generation of mothers analysed in this study may be happier when they are able to combine family life with a paid (part-time) job. However, while several studies have addressed the question of whether partnered women in the Netherlands prefer part-time over full-time jobs (e.g. Booth and Van Ours 2010; Bosch et al. 2010; Portegijs et al. 2006), we are not aware of any studies that have analysed whether working mothers are indeed happier than non-working mothers in the Netherlands. Recently, Berger (2012) showed that, in Germany, full-time working mothers are more satisfied with their lives than mothers who are not working due to family reasons and mothers in small part-time jobs (less than 20 h per week). However, Johnson et al. (2012) found that maternal work has differentiated effects on children's cognitive and non-cognitive skills, depending on the extent of job stability and the job's cognitive skills requirements. These studies illustrate the need for further research on the driving mechanisms behind the positive relation between maternal employment and the cognitive development of young school-aged children.

Our findings suggest that a high rate of labour market participation among mothers of school-aged children is positively related to children's cognitive development, provided that the mothers work about the number of hours that the children attend school (approximately a large part-time job). This is an important conclusion, since research (e.g. Currie and Thomas 2001) has shown that early child outcomes are good predictors of economic outcomes at later ages.

Moreover, our findings suggest that it could be beneficial for school-aged children if their mother re-entered the labour market or increased their work hours, because maternal employment is positively associated with the cognitive development of children. Especially in the Netherlands, but also in Germany and the United Kingdom, mothers do not usually return to their pre-maternity work hours, even after their children are older and start school (Bosch et al. 2010; Paull 2008).

Appendix 1

See Fig. 4 and Tables 6–10.

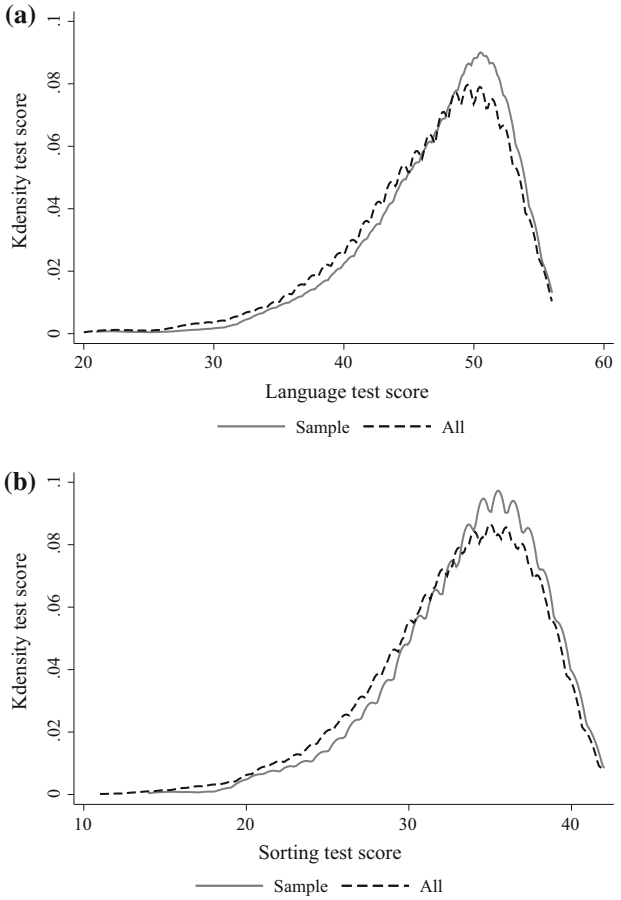

Fig. 4 Distribution of test scores for sample and population. **a** Language test **b** Sorting test

Table 6 Factor loadings on children's non-cognitive skills

Items	Factor 1 Inquisitiveness	Factor 2 Individualism	Factor 3 Difficulty	Factor 4 Sociability
Oriented towards other children			0.3033	0.7324
Adapts easily				0.6226
Independent		0.7464		
Smart	0.4799			
Imagination in somebody else's situation		0.7225		
Chaotic		0.4895		
Easygoing		0.7463		
Can amuse oneself			0.5426	
Focussed on herself/ himself				0.7062
Cheerful				0.7318

Table 6 continued

Items	Factor 1 Inquisitiveness	Factor 2 Individualism	Factor 3 Difficulty	Factor 4 Sociability
To be quick on the uptake	0.5033			
Friskily	0.7846			
Complaining	0.7523			
Quiet	0.4906	0.3309		
Bothersome	0.3484		0.4554	
Talks a lot		0.312	0.6138	
Precise			−0.3269	
Frivolous				
Nice		0.4649		
Scared				0.3543
Leisurely	0.7631			
Creative	0.7901			
Thoughtful	0.7683			
Systematic	0.3622		0.5873	
Timid		0.3697	0.3454	
Spontaneous			0.3056	
Gripped			0.7254	
Easy	−0.4006	0.6226		
Irascible			0.7804	
Inquisitive	0.3997			
Interested	0.5996			
Active		0.6686		
Nasty	0.7181			
Gets tired easily		0.3858	0.3532	
Keeps distance			0.5976	
Kind				0.5168
Slowly	−0.3066	0.364	0.604	0.3539
Reserved		0.6904		
Contacts others easily	0.8021			
Jumpy		0.4155	0.4582	
Healthy	0.6826			
Imaginative	0.6642			

Table 7 Factor loadings on parental views on traditional gender divides

	Factor 1 Parental views
To what extent do you agree/disagree to the following statements	
Going to college is more important for boys than for girls	0.2290
Marriage is old-fashion	0.0276
Our children will have a better life than we have	0.3506
Home work is at least as satisfying as is paid work	0.2072
Men are often better politicians than women	0.5067
Children need a family with both a mother and a father	0.2267
Religion is very important to me	0.2360
I am jealous at the opportunities of the youngest generation	0.3122
Children need to be prepared to school at an early stage	0.2871
Early child care is important for children's development	0.0754
It is important that children do well at school	0.4049
Women are allowed to be mother without a stable relationship	−0.2948
Men do mostly a better job in managing occupations	0.5449
My child needs to go to a school nearby	0.1287
I assume that our children will have a better life than we have	0.2966
At school children should have to work hard	0.3635

Table 8 Factor loadings on parenting goals related to their child's independence

	Factor 1 Parenting goals
How important is it to you that your child learns	
To be economical	0.4436
To know what is going on in the world	0.4309
To be hardworking	0.3737
To stand one's ground	0.4038
To take time for her/himself	0.6110
To fight for her/himself	0.5967
To develop imagination	0.5304
To indulge her/himself	0.5629
To be tolerant towards others' opinions	0.5792
To be independent	0.5575
To not let her/himself be rushed	0.6073
To be satisfied with what she/he has	0.6081
To show persistence	0.5884
To be religious	0.2766
To show solidarity	0.5129
To obey	0.4628

Table 9 Summary statistics of control variables

	N	Mean	SD	Min	Max
Maternal educational level					
Low	2,058	0.18	0.39	0	1
Medium	2,058	0.5	0.5	0	1
High	2,058	0.32	0.47	0	1
Year of birth mother	2,058	1,971	3.86	1,960	1,998
Mother speaks Dutch with the child	2, 058	0.95	0.23	0	1
Paternal educational level					
Low	2,058	0.19	0.39	0	1
Medium	2,058	0.4	0.49	0	1
High	2,058	0.41	0.49	0	1
Year of birth father	2,058	1,969	4.03	1,959	1,985
Father speaks Dutch with the child	2,058	0.95	0.21	0	1
Boy	2,058	0.51	0.5	0	1
Number of children living in the household	2,058	3.1	0.71	2	7
Are there any grandmoms/dads living in the household?	2,021	0.008	0.09	0	1
Are there any aunts/uncles living in the household?	1,968	0.002	0.04	0	1
Are there any other adults living in the household?	1,966	0.004	0.06	0	1
Cohort	2,058	2.49	0.5	2	3
Child speaks Dutch with friends	2,058	0.99	0.11	0	1
Did a fundamental event occur that affected child's development?	2,058	0.05	0.22	0	1
Extent to which child has difficulties with emotions	2,036	0.19	0.45	0	3
Extent to which child has difficulties with concentration	2,040	0.29	0.55	0	3
Extent to which child has difficulties with behavior	2,035	0.15	0.4	0	3
Extent to which child has difficulties with dealing with other people	2,025	0.07	0.3	0	3

Whereas the sample size is 2,058, some variables in the table have lower numbers of observations. This is due to missing values. In the analyses, we include dummy variables for all possible values of these values, including a dummy for missing values. Other control variables not mentioned in the table are standardized (factor) variables with mean equal to zero and a standard deviation equal to one. It concerns parental views, parenting goals, and the four non-cognitive skills (inquisitive, individual, difficult and sociable). Moreover, the table excludes summary statistics on mothers', fathers' and children's religion as we include several religion dummies that are not so informative

Table 10 Full table with main results

Dep. var.: test scores year 2 (std)	Language test b/se	Sorting test b/se
Parental characteristics		
Maternal employment (ref: no job)		
Small part-time job	0.093	0.129
	(0.097)	(0.114)
Large part-time job	0.115**	0.121**
	(0.055)	(0.061)
Full-time job	0.101	0.177**
	(0.068)	(0.077)
Maternal education (ref: low educated)		
Medium educated	0.148***	0.078
	(0.057)	(0.065)
High educated	0.220***	0.031
	(0.067)	(0.076)
Paternal employment (ref: full-time job)		
Part-time job	–0.030	0.116
	(0.088)	(0.096)
No job	0.144	0.018
	(0.120)	(0.136)
Paternal education (ref: low educated)		
Medium educated	−0.026	0.113*
	(0.056)	(0.063)
High educated	0.009	0.174**
	(0.061)	(0.068)
Birth year mother	−0.005	0.006
	(0.007)	(0.007)
Mother speaks Dutch to child	0.087	−0.197
(yes/no)	(0.110)	(0.121)
Birth year father	−0.002	−0.005
	(0.006)	(0.007)
Father speaks Dutch to child	−0.189	0.063
(yes/no)	(0.121)	(0.138)
Parental views	−0.014	−0.024
On traditional gender divides	(0.024)	(0.026)
Parenting goals	−0.026	0.029
Related to their child's independence	(0.020)	(0.022)
Joint daily activities	0.002	−0.007
	(0.012)	(0.014)
Planned activities	0.035*	−0.008
	(0.019)	(0.021)

Table 10 continued

Dep. var.: test scores year 2 (std)	Language test b/se	Sorting test b/se
Household characteristics		
Number of children in the	−0.042	−0.010
Household	(0.027)	(0.031)
Grandpa/ma in the	−0.010	0.010
Household (yes/no)	(0.019)	(0.021)
Oncles/aunts in the	0.001	0.016
Household (yes/no)	(0.023)	(0.025)
Other adults in the	−0.002	−0.015
Household (yes/no)	(0.020)	(0.023)
Child characteristics		
Cohort	−0.018	−0.046
	(0.040)	(0.045)
Child speaks Dutch to friends	−0.295	−0.222
(yes/no)	(0.216)	(0.202)
Child experienced a situation that potentially affects	−0.043	−0.188*
Child development, like divorce (yes/no)	(0.087)	(0.098)
Child has difficulties with emotions (ref: no)		
Yes, little	0.087	0.116*
	(0.060)	(0.067)
Yes, clearly	0.221	0.024
	(0.152)	(0.175)
Yes, strongly	−0.237	0.674
	(0.588)	(0.604)
Child has difficulties with concentration (ref: no)		
Yes, little	−0.125**	−0.154***
	(0.050)	(0.056)
Yes, clearly	−0.160	−0.265**
	(0.114)	(0.129)
Yes, strongly	0.090	−0.118
	(0.305)	(0.335)
Child has difficulties with behaviour (ref: no)		
Yes, little	0.072	0.009
	(0.071)	(0.079)
Yes, clearly	0.024	−0.326
	(0.188)	(0.218)
Yes, strongly	0.454	−0.529
	(0.861)	(0.892)

Table 10 continued

Dep. var.: test scores year 2 (std)	Language test b/se	Sorting test b/se
Child has difficulties with coping with other people (ref: no)		
Yes, little	−0.336***	−0.145
	(0.101)	(0.118)
Yes, clearly	−0.642***	0.109
	(0.235)	(0.261)
Yes, strongly	0.758	0.662
	(0.581)	(0.594)
Boy	−0.055	−0.067
(yes/no)	(0.038)	(0.042)
Non-cognitive skills		
Inquisitiveness	0.040*	0.040
	(0.023)	(0.025)
Individualism	−0.061***	−0.043*
	(0.022)	(0.025)
Difficulty	0.005	−0.008
	(0.022)	(0.024)
Sociability	0.023	−0.014
	(0.022)	(0.024)
First-year test score	0.447***	0.449***
	(0.021)	(0.024)
Constant	15.375	−0.763
	(10.663)	(12.133)
Adj. R-squared	0.259	0.236
N	1989	1676

Religious dummies, as well as dummies denoting missing values, are excluded from the table

Appendix 2: Home-Environment

Questions related to joint daily activities (DA_h) are asked in the following way: *In their joint daily activities, children do lots of things together with their parents. What applies to your child?* The activities referred to are the following:

- Playing with toys inside with your child
- Playing outside with your child
- Playing on a computer with your child
- Drawing/painting with your child
- Making up stories with your child
- Going to the sports club or swimming pool with your child
- Watching children's programs on TV with your child
- Watching TV/video (other programs) with your child
- Reading stories to your child

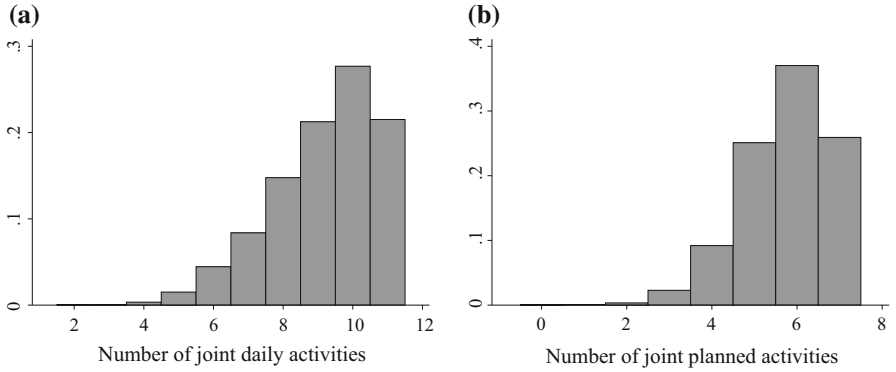

Fig. 5 Distribution of joint parent-child activities. **a** Joint daily activities **b** Joint planned activities

- Reading stories focused on development to your child
- Talking about school with your child

We know when at least one of the parents undertook the abovementioned activities with their child, but we do not know which parent. We construct a variable measuring the number of joint activities parents undertook with their child.[33]

Questions dealing with planned activities (PA_h) are asked in the following way: *When was the last time you (or your partner) went on a trip together with your child?* The trips referred to are the following:

- Visiting a museum with your child
- Going to a swimming pool with your child
- Going to a sports club with your child
- Going to a zoo with your child
- Going to a library with your child
- Going to a park or forest with your child
- Going to an amusement park with your child

Possible answers are 'today', 'in the last week', 'some weeks ago', 'some months ago', 'more than half a year ago', and 'I rarely do'. 'I rarely do' was coded zero and all other answers were coded one. We then calculated an index for the number of joined planned activities as the sum of all activities parents undertake with their child.

Figure 5 plots the distribution of the number of joint daily and planned activities: Panel (a) shows that only a few parents undertake less than five joint daily activities with their child. About 10 % of the parents undertake 7 out of the 11 activities with their child. Undertaking 9, 10, or even 11 joint activities is most common in the sample. Panel (b) shows that most parents undertake at least five out of seven planned activities with their child. Both distributions seem to be truncated.[34]

[33] Our results are similar when we leave out items for which the direction of the parent-child interaction is less obvious such as 'Watching children's programs on TV with your child' and 'Watching TV/video (other programs) with your child'.

[34] This suggests that not all activities parents undertake with their children are mentioned in the questionnaire. However, since the distribution is similar for boys and girls, this is not a problem in our analyses.

Table 11 Joint daily activities per maternal employment status

	Joint daily activities Mean	Joint planned activities Mean
No job	9.1	5.5
Small part-time	9.3	5.8
Large part-time	9.2	5.8
Full-time	9.2	5.7
Total	9.2	5.8

This table reports the average number of joint daily activities per maternal work status. The total number of joint daily activities equals 11, the total number of joint planned activities equals 7

In Table 11, the average joint daily and planned activities are reported. These averages are reported for the full sample, and differentiated across maternal work status. From the table we do not see a clear relation between maternal work status on the one hand, and the average number of joint parent-child activities on the other. However, correlations show a significant relation between work hours (as measured by the four categories) and the number of planned activities.

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