Child Development, Family structure, and Time investments

Hélène Le Forner *

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Abstract

While a large number of studies emphasizes a negative effect of parental separation on child development, little attention has been paid to the channels of this effect. This paper shows that child and parental time investments could be a driving channel of the negative effect of parental separation. Using detailed time-use diaries from the PSID-Child Development Supplement, I estimate an individual fixed effects model and find that being in a single parent family has a negative impact on time spent with at least one parent present. Times with parents together and with fathers (only) are highly affected, but mothers compensate partially for this decrease. Besides, to see if it matters for child development, I estimate cognitive and non-cognitive skills production functions using several specifications. I shed light on the heterogeneity of parental time investments for emotional and cognitive skills. Child and parental time investments appear to be a possible driving channel of the effect of parental separation, especially at stake for children whose parents get separated in their early childhood and children with more highly educated parents.

JEL classification: I21, J12, J13, J24

Keywords: Child Development; Child's Time Investments; Parental Time Investments; Family Structure; Cognitive Skills; Non-cognitive Skills.

*Université Paris I Panthéon-Sorbonne - Paris School of Economics (PSE), 48 Boulevard Jourdan, Bureau R3-68, 75014, Paris, France. Email: helene.le.forner@gmail.com. Phone: +33 6 78 46 70 79

1 Introduction

This paper analyses whether child and parental time investments are a driving channel of the negative effect of parental separation on child development. While a large number of studies emphasize a negative effect of parental separation on child development (see Ermisch and Francesconi 2001 [4]; Frimmel et al 2016 [7]; Gruber 2004 [9]; Francesconi et al 2010 [6]; Clark et al 2015 [1]; and Ribar et al 2017 [18]), little is known about the possible channels of this effect. I focus here on child and parental time investments. This analysis is in two parts. First, this paper estimates how family structure impacts child and parental time investments. This offers an interesting framework to estimate whether parental times are complements or substitutes. The substitution of time with the non-custodial parent is a key element in this analysis. Second, using cognitive and non-cognitive production functions, I estimate what activities are relevant for child's cognitive and non-cognitive skills, and whether, this is affected by the presence or the involvement of parents. Since parental times composition is likely to be highly affected by being in a single parent family; this paper investigates whether it is the same to spend time with the mother only rather than with the father or both parents together. I also allow for production functions to vary across gender, family background and age.

This paper offers three main contributions. First, it investigates the driving forces of the effect of parental separation on child development. Second, it extends the parental times literature (see Fiorini and Keane 2014 [5]; Del Bono et al 2017 [3]; Funk and Kemper (2016) [8]; Del Boca et al 2017 [2]) to time spent with fathers and with both parents, two key variables to understand the impact of being in a single parent family on parental times investments. I also provide evidence that parental times are substitutes rather than complements. Third, this paper improves the understanding of cognitive and non-cognitive skills production functions by exploring the possible heterogeneity of parental times.

I use the Panel Study of Income Dynamics - Child Development Supplement (PSID-CDS). It provides time-use diaries for 2600 children first interviewed in 1997 and followed in 2002 and 2007. It collects the activity, the duration, and who was present or involved during the activity. Cognitive and non-cognitive skills are also available. I consider five activities (house)work, personal needs and care, education, active and passive leisure. Among time with at least one parent, we can distinguish time with only the mother, only the father and with both parents together. I use an individual fixed effect model to estimate the impact of being in a single parent family on child and parental time investments. To account for unobserved child's characteristics in the cognitive and non-cognitive skills production functions, I consider three strategies commonly adopted: the value added, the fixed effect model and the cumulative value added model. I draw attention on two new findings. First, being in a single parent family has

a negative impact on time with at least one parent present; substitution between parental times is not perfect. The composition of accessible (when the parent is at least around) and engaged parental times (when the parent is involved in the activity) is highly affected. Second, all parental times do not have the same impact on reading and non cognitive skills: time spent with the father or both parents together do not have the same impact than time spent with the mother. Also, results suggest that time input production functions (the effect of time investments on child development) vary across gender and parents education.

Therefore, based on the empirical evidences gathered here, it appears that time investments could be a driving channel of the effect of parental separation on child development. On one hand, the decrease in the accessible time of parents may explain negative effect on emotional skills, especially for girls. Also, the channel of allocation of time may be particularly at stake for children whose parents get separated in their early childhood. On the other hand, the change in the composition of parental times may be a driving channel of the effect of parental separation on reading and non cognitive skills, especially for children with more highly educated parents.

The remainder of the paper proceeds as follows. Previous related literature is presented in the next section. In section 3, a description of data, main variables and some descriptive statistics are provided. The identification strategy is explained in section 4. Section 5 shows the results and sensitivity analysis. Section 6 concludes.

2 Previous Findings

An extensive body of literature points out a negative effect of parental separation on child's development, even after controlling for selection. Parental separation is costly for parents. Separation implies to lose production and consumption complementarity or risk pooling made as a couple. Parental separation can also have a psychological impact on children. However, parental separation is probably correlated with parent's unobserved characteristics, the main example is the level of conflict between parents. Researchers have employed several methods to handle with this selection issue: siblings-differences, instrumental variables, control for conflicts. Some studies still find a negative effect even after taking into account the endogeneity problem (see Ermisch and Francesconi 2001 [4]; Frimmel et al 2016 [7]; Gruber 2004 [9]; Francesconi et al 2010 [6]; Clark et al 2015 [1]; and Ribar et al 2017 [18]). However, not much is known about the channels of this negative effect.

Economic theoretical literature has long pointed out the importance of parental time in determining child attainment. Yet, there are surprisingly few empirical studies that analyse the effect of time allocation and

parents' time investments on child's human capital. Much of the existing findings are based on mother's employment used as a proxy for maternal time. A burgeoning literature tries to fill this gap using time diaries data or at least direct measures of parental times. Using time diaries from LSAC [1], Fiorini and Keane (2014) [5] find that educational activities, particularly with parents are the most productive input for cognitive skills. Non-cognitive skills seem insensitive to differences in time allocation. Del Bono et al (2016) [3] highlight that maternal time is a productive input for both cognitive and non-cognitive skills, especially in early childhood. They emphasize a feedback effect, meaning that mothers invest less on time inputs when children do well cognitively; maternal time has a long term impact.

Other studies focus also on child's own time investments. Using time-use diaries from the Panel Study of Income Dynamics-Child Development Supplement (PSID-CDS), Funk and Kemper (2016) [8] emphasize the effect of listening to music and learning for both math and reading skills. Del Boca et al. (2017) [2] highlight that time input production functions vary across age: maternal time matters in childhood, but child's own time investment is more productive during adolescence.

This paper aims to bridge the gap between these two strands of the literature, wondering how child and parental time investments can be a channel of the negative effect of divorce. Using the American and the United Kingdom Time-Use Surveys (ATUS and UKTUS), Kalenkoski et al (2007) [12] show that single parents spend more time with their children, when observed selection is controlled. Kendig and Bianchi (2007) [13] and Le Bourdais and Rapoport (2001) [14] find similar results for the United States and Canada respectively. Mencarini et al (2014) [16] is the closest paper to mine. Instrumenting single parent families by parents' religious participation, they find that being in a single parent household reduces the amount of time spent reading and studying, this effect is driven by poorer families, only children and boys.

Most studies focus on maternal time. Paternal time and time spent with both parents together are two key missing variables in these analysis, although they will be highly affected by parental separation. Responses of the custodial parent are uncertain. She can compensate for the decrease in other parental time investments. Hsin and Felfe 2014 [11] suggest that working mothers protect productive maternal time. Clark et al (2015) [1] find little evidence of an effect of early maternal employment on child's emotional outcomes; fathers may compensate with an increase in their own time investments, or parents could adopt alternative childcare arrangements. On the other hand, Pailhé and Solaz (2004) [17] find evidence of complementarity of leisure time, parents have a preference to do leisure together with children.

Besides, if there is a total substitution, we can wonder if all parental times investments have the same

[1] Longitudinal Study of Australian Children

impact on child development. Spending one hour with parents together could have the same impact as one hour with each parent if it is the time spent with the parent that matters instead of time spent in a particular activity, or even more valued if family time matters.

3 Data

The Panel Study of Income Dynamics began in 1968 with a nationally representative sample in the United States. Information on these individuals and their descendants has been collected continuously. We could recover intergenerational information for all families.

The PSID - Child Development Supplement (PSID-CDS) follows 2650 children first interviewed in 1997, then in 2002 and 2007. Figure 1 shows that children are between 0 and 14 years old in the first sample, 4 and 19 years old in the second wave (2002), and between 10 and 19 in the third wave (2007). A large part leaves the sample in the third wave due to age limit (they are above the age of 19, see Figure 1).[2] The sample is not big, but the survey collects a rich set of information about children's cognitive skills, non-cognitive skills, demographics and parental background, along with time-use diaries for two days, one in the week and one in the weekend. The child fills the time diary when it is possible, and the primary care giver does it when it is necessary. Time diaries provide information on the activity, where the activity took place, and with whom. As far as we know, the only panel data with time-use diaries is the Longitudinal Study of Australian Children (LSAC). Despite the larger sample of the LSAC, and the advantage to be biannually surveyed, results from Australia on the effect of parental separation on children have been mixed, this makes the CDS a more appropriate dataset to study the channels of the effect of parental separation.

3.1 Time investment variables

Children must fill the time-use diary for one day in the week and one day in the weekend, picked randomly at the beginning of the survey, no substitution is possible. He fills the time diary on a 24 hours continuous basis, avoiding measurement errors. The child has to provide the activity, the duration, the location, who was present at the moment of the activity and who was involved. It allows measuring time investments in each activity for a representative week (in hours), using a weighted average of time investments in the week and in the weekend.

The day is divided into five categories: Work and housework; Personal needs and care including sleeping

[2] A more detailed description of attrition is done in Section 5.3

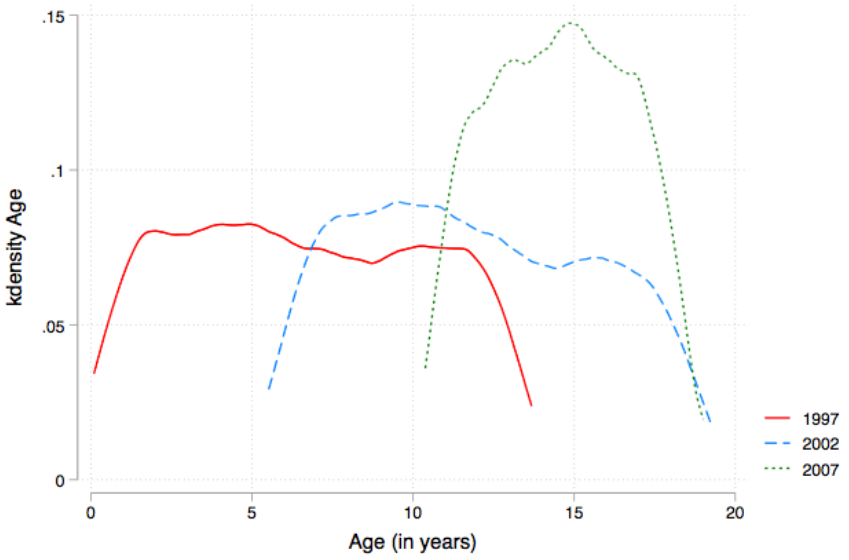


Fig. 1. Age distribution for each wave

time; Education including reading time; Active leisure (sports, dance, going to the theatre) and Passive Leisure (Watching TV, Arguing). Figure 2 shows how children spend their week into these 5 categories. Note that the study focuses on the primary activity. Children spend a small part in housework and work activities. They spend half of the day in personal needs and care (including sleeping). The rest of the representative day is divided between educational activities, active and passive leisure.

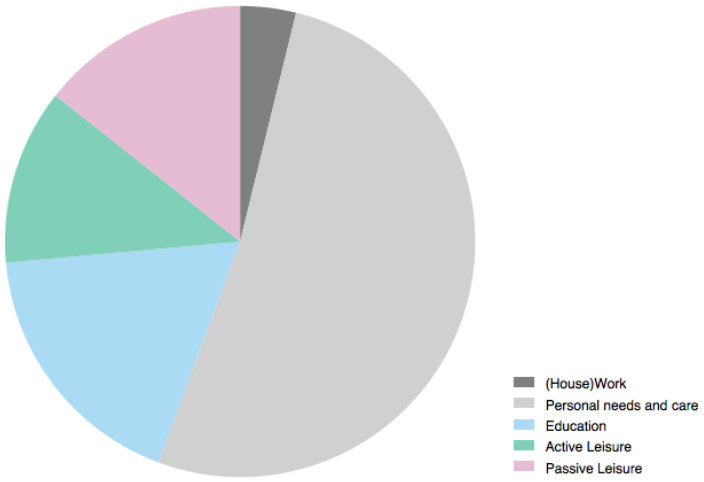
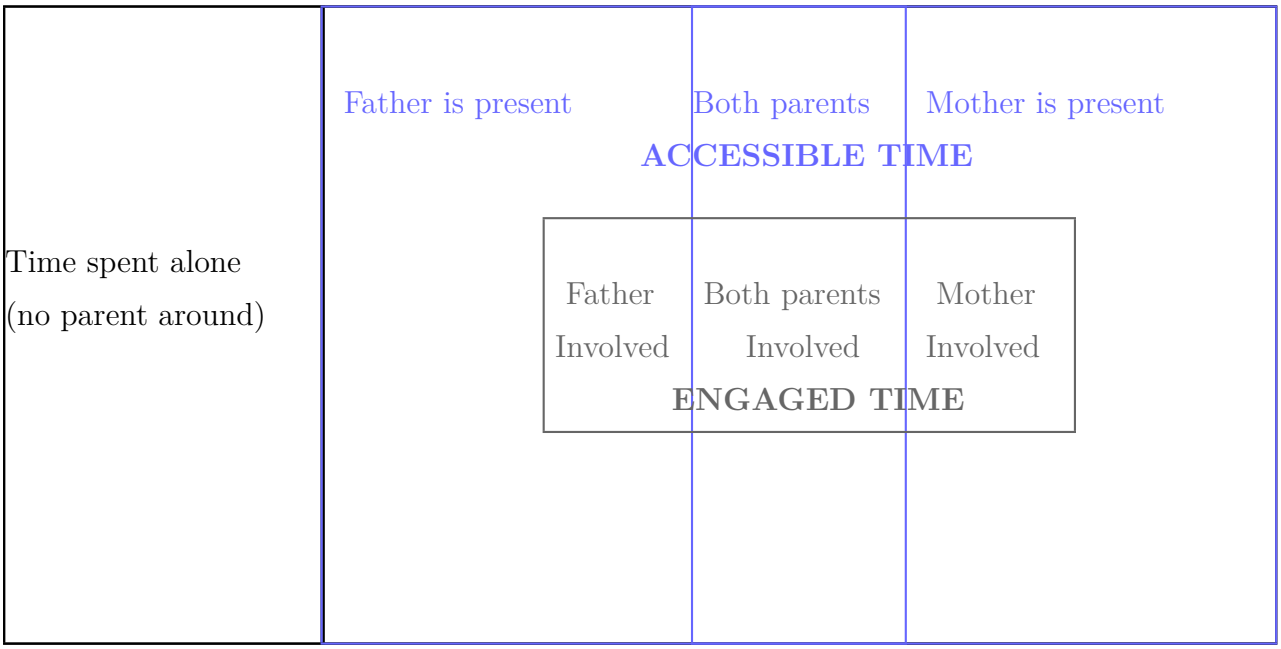


Fig. 2. Decomposition of Time Allocation in 5 activities

For each activity, time spent alone, with the mother only, with the father only and with both parents are distinguished. We also consider time spent with at least one parent. We analyse time spent with a parent involved in the activity (engaged time) and also present in the activity (accessible time) (see

Hofferth and Sandberg (2001) [10]).

Before looking at parental time investments, I first look at time investments whoever is with the child. Then, along time investments, I distinguish time spent alone from time with at least one parent, the latter can be decomposed again into three different parental times: time with the mother only, time with the father only and time with parents together. Time with other adults such as step-parent and grand parents, are also measured. The scheme bellow describes the decomposition of parental times. As far as we know, this is the first study analysing time spent with parents together. No much attention has been paid to paternal time either. Figure 3 shows the decomposition of time according to who is involved in the activity. The first graph shows the decomposition of time for a representative day. "Not relevant" means that the child is supposed to the activity by his own. The child could be doing the activity alone, with at least one adult, or with someone else ("other"): a sibling, a half-sibling, other relative or non relative. I exclude this latter category in the rest of the study because we do not have many information (age, sex...) on these individuals. In the second graph, we can see the decomposition of time with at least one adult. It is mainly time with at least one parent, time with grand-parent (only) or time with one parent and someone else (grand-parent or step-parent). The last graph shows the decomposition of time with at least one adult. More than half of parental time investments is time with the mother only, and more than 75% of the time with at least one parent is time with at least the mother. In the rest of the paper, we exclude other parental time (time spent with at least one parent and someone else), because we do not have many information on the effect of time spent with a step-parent on child development.



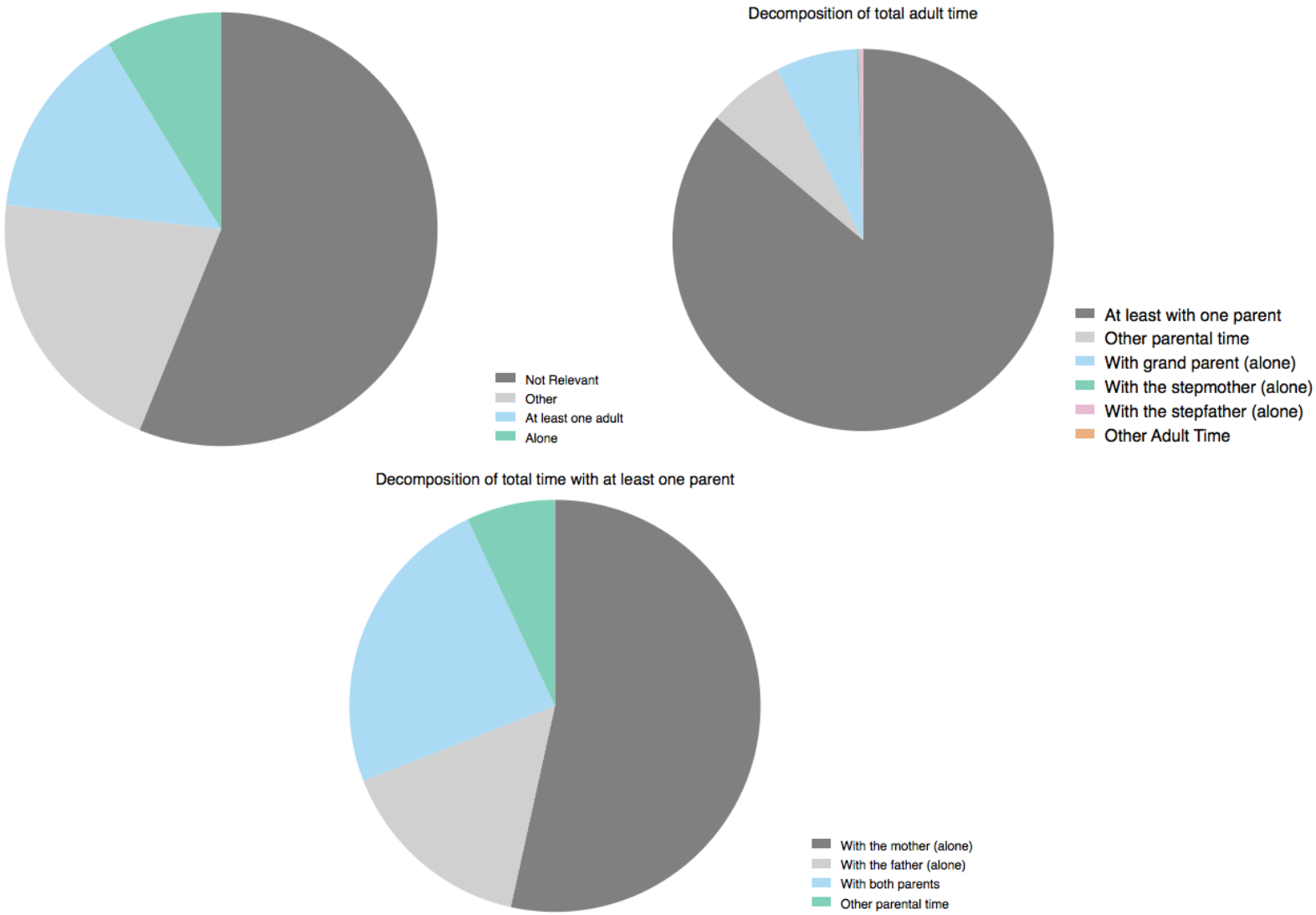


Fig. 3. Decomposition of Time Investments (engaged time)

3.2 Child development measures

Cognitive skills. Cognitive skills measure the ability to perform in mental activities. Cognitive tests come from the Woodcock-Johnson Revised Tests of Achievement (WJ-R). It starts from the easiest question to the most difficult. PSID-CDS dataset provides two tests about reading and verbal abilities and another test about logical abilities. Scores in the Letter-Word Identification test (from the age of three) and in the Passage Comprehension test (from the age of six) give the Broad Reading test score. The Broad Math test score is the score of the Applied Problem Test, applied from the age of three. The scores are available in four formats: raw score, standardised score on the national average for an age group for a mean of 100 and a standard deviation of 15, W score that accounts for the difficulty of the question and the percentile rank. The standardised test scores are used in the rest of analysis.

Non-Cognitive skills. Non-cognitive skills are other skills including emotional maturity, empathy, non-verbal communication, and social behaviour. To measure the non-cognitive skills, I use the Behaviour Problem Index (BPI), designed by Peterson and Zill (1986) to measure the frequency and type of childhood behaviour problems for children aged 3 and older. The BPI is based on responses from the Primary Care Giver about the child's behaviour and feelings. The BPI can be decomposed in two parts: the internalising BPI (goes from 0 to 14 initially) and the externalising BPI (goes from 0 to 17 initially). The former accounts for how the child feels and takes into account problems of self-esteem, reveals feelings of not feeling loved, feeling anxious, easily confused, feeling inferior, depressed, too dependent or if he worries too much; while the latter accounts for how child behaves, taking into account nervousness, arguing or lying, concentration problems, social problems, and hyper-activity. For the easiness of the interpretation, scales have been reversed: a positive effect on this rescaled BPI is good for child's development.

All the child development variables are standardised for a mean of 0 and a standard deviation of 1.

3.3 Family Structure

For family structure, I keep five family types: children who live with their two parents; with their mother only; with their mother who has a partner living or not with the child; with their father and others (child does not live neither with his mother, nor with his father).
Dummies are also included to control for the absence of father (at birth) and for the death of parents. But too few observations are concerned for these latter variables to be able to draw any conclusion.

Table . 1 shows the transition matrices for family structure from wave 1 to wave 2, and from wave 2 to wave 3. All the families who remain single mother families with a step-parent or not, or single father families or others (on the diagonal) are excluded from the fixed effect analysis. The rest of the observations enable to identify the effect of family structure.

3.4 Other controls

Controls on individual's characteristics and his family are included. Sex, Age, Ethnicity, Primary Care Giver (PCG)'s status of employment, education and earnings; and Number of siblings. Table . 2 shows the summary statistics for these control variables on the whole sample, for each wave. The average age is around 6 years old, 12 years old and 14.5 years old for each wave, respectively. Half of the sample is white. The share of children who live with their two parents is around 64% in the first wave and decreases across waves, on the other hand, the share of children who live with their single mother increases.

Table . 1 – Transition in family structures from 1997 to 2002 and from 2002 to 2007

		Family structure in wave 2						
Family structure in wave 1		Two parents	Single Mother	Single Mother with SP	Single Father	Other	Attrition	Total
	Two parents	1144	133	29	23	11	351	1691
	Single Mother	34	300	81	8	18	206	647
	Single Mother with a step parent	7	25	43	1	6	48	130
	Single Father	3	0	4	22	6	17	52
	Other	2	12	11	5	29	43	102
	Unknown	16	14	1	0	1	0	32
	New individuals	59	60	11	5	10		145
	Total	1265	544	180	64	81	665	2799

		Family structure in wave 3						
Family structure in wave 2		Two parents	Single Mother	Single Mother with SP	Single Father	Other	Attrition	Total
	Two parents	570	63	6	10	10	606	1265
	Single Mother	18	200	38	3	10	275	544
	Single Mother with SP	2	15	54	0	6	103	180
	Single Father	3	2	0	17	3	39	64
	Other	0	10	5	2	23	41	81
	Unknown (A_13)	56	45	19	6	14	140	
	New individuals	13	13	2	1	3		32
	Total	662	348	124	39	69	1064	

Table . 2 – Summary Statistics

	1st wave				2nd wave				3rd wave			
	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
Age	6.63	3.77	0	14	11.92	3.67	6	19	14.55	2.16	10	19
Female	0.49	0.50	0	1	0.50	0.50	0	1	0.49	0.50	0	1
White	0.50	0.50	0	1	0.51	0.50	0	1	0.50	0.50	0	1
African american	0.37	0.48	0	1	0.36	0.48	0	1	0.37	0.48	0	1
Hispanic	0.08	0.26	0	1	0.08	0.27	0	1	0.08	0.27	0	1
Asian Pacific	0.02	0.13	0	1	0.02	0.13	0	1	0.02	0.14	0	1
American Indian	0.00	0.06	0	1	0.00	0.05	0	1	0.00	0.03	0	1
Other	0.03	0.18	0	1	0.03	0.18	0	1	0.03	0.16	0	1
Two Parents	0.64	0.48	0	1	0.59	0.49	0	1	0.53	0.50	0	1
Single Mother	0.25	0.43	0	1	0.26	0.44	0	1	0.28	0.45	0	1
Single Mother (step-parent)	0.05	0.22	0	1	0.08	0.28	0	1	0.10	0.30	0	1
Single Father	0.02	0.14	0	1	0.03	0.17	0	1	0.03	0.17	0	1
Other	0.04	0.19	0	1	0.04	0.19	0	1	0.06	0.23	0	1
PCG - Worker	0.63	0.48	0	1	0.73	0.45	0	1	0.78	0.41	0	1
PCG - Looking for work	0.08	0.26	0	1	0.05	0.21	0	1	0.05	0.22	0	1
PCG - Housewife	0.25	0.43	0	1	0.19	0.40	0	1	0.15	0.35	0	1
PCG - Student	0.04	0.18	0	1	0.02	0.13	0	1	0.01	0.12	0	1
PCG - Other	0.01	0.09	0	1	0.02	0.12	0	1	0.00	0.07	0	1
Earnings	9.47	1.04	3	13	9.79	0.98	4	13	9.79	1.30	2	12
Observations	2594				2129				1244			

4 Estimation

4.1 Estimating the effect of family structure on children's and parental time investments

I estimate the impact of family structure on child and parental time investments using an individual fixed effect analysis. A common identification problem comes from the correlation between family structure and unobserved variables that could affect child and parental time investments. Selection into separation has long been recognised as an estimation issue by economists (see Section 2). A fixed effect model handles with selection, since it gets rid off all time-invariant variables, observed or not.

Let TI_{it}^{k} be a vector of time inputs measured by the total amount of time spent in activity k at time t (no matter who was there); and PTI_{it}^{kP} a vector of parental time inputs spent with parent P in activity k. These two variables are standardised for a mean of 0 and a standard deviation of 1. FS_{it}^{k} is a set of dummies indicating family structure at time t. Z_{it} denotes all control variables described above. The effect of family structure can be estimated following this equation:

$$\Delta(P)TI_{it}^{k} = \delta_1 \Delta FS_{it} + \delta_2 \Delta X_{it} + \Delta\epsilon_{it} \tag{1}$$

where ΔX_{it} indicates the difference between the variable X_{it} at time t and its mean across waves at the individual level $X_{i.}$. δ_1 measures the effect of a change in the family structure on the amount of time spent in the activities.

The fixed effect model rules out endogeneity issues due to correlation between family structure and invariant variables. It relies on the assumption that the family structure is not due to an unobserved change in one of the parents' or child's behaviour or characteristics.

Once we estimate the effect of family structure on child and parental time investments, we wonder if these changes matter for child's development.

4.2 Estimating Time Input Production Functions and the effect of the presence or involvement of parents

I estimate time input production functions using the approach developed by Todd and Wolpin (2007) [19], and also applied by Fiorini and Keane (2014) [5], Del Bono et al (2016) [3], and Del Boca et al (2017) [2]. The aim of this analysis is to look at the importance of time spent with parents, and to assess the possible heterogeneity among parental time investments looking if child's development depends on

whom is involved or present during the activity. One of our main interest is to look at time spent with both parents together.

Simple correlations between time inputs and child's outcomes are difficult to disentangle from causal relations. According to Fiorini and Keane (2014) [5], endogeneity can come from three sources: a) omitted variables such as unobserved child's ability; b) reverse causality, spending more time reading could foster child's reading test score, but higher abilities in reading could also lead to a larger taste in reading; and c) measurement errors in outcomes and amount of time spent in the activity. The latter could come from recall errors, or self-report bias, children could lie about the amount of time spent in homework or overestimate activities that they consider as more socially valuable. Besides, we only have time diaries for two days in a week, picked randomly in a year, these measures are subject to transitory shocks. If the family planned to go to Disneyland this day, it is unlikely to be representative of daily child's time-use.

I handle with omitted variables bias by controlling for past test score. Reverse causality would be a problem if an increase in reading test score triggers an increase in time spent in reading, which cannot be excluded. Using time diaries avoid measurement error; especially we can assume that children are less willing to overestimate the amount of time they spend in more socially valuable activities. Still, they could lie about the time they spend in studying if they fear that their parents check their answers. Moreover, we are aware that two days picked randomly could lead to measurement error, similar to measurement errors highlighted in income literature when current earnings are used instead of permanent earnings, but unfortunately, there are only two panel data in the world that provide time diaries filled by children, and no one provides more detailed information. Obviously, asking for more frequent surveys would decrease the number of respondents willing to be surveyed, which leads to larger attrition.

Let me start by presenting the cumulative value added model. Let Y_{it} be the outcome of individual i in wave t. I consider 5 particular outcomes: Broad Reading test score, Math test score, Total BPI (Behaviour Problem Index), Internalising BPI, Externalising BPI. As mentioned before, TI_{it}^{k} and PTI_{it}^{kP} are the vectors of total time inputs (whoever was there) and parental time inputs respectively. Let PTI_{it-1}^{kP} be the vector of parental time inputs in previous wave $t-1$. Putting aside the role of other conditioning variables for the sake of simplicity, the time input production function can be written as:

$$Y_{it} = \beta_0 + \Sigma_1^k \gamma_1^k TI_{it}^k + \Sigma_1^P \Sigma_1^K \gamma_2^{kP} PTI_{it}^{kP} + \Sigma_1^P \Sigma_1^K \gamma_3^{kP} PTI_{it-1}^{kP} + \lambda Y_{it-1} + \epsilon_{it} \tag{2}$$

Y_{it-1} is the individual's outcome in the previous wave. It catches learning persistence, but it is also a

proxy for unobserved ability. γ_1^k measures the impact of spending 1 stantard deviation more in activity k. γ_2^{kP} catches the effect of the presence or the involvement of a parent during the activity. γ_3^{kP} measures the effect of the presence or the involvement of parents in the previous wave, this allows for feedback effects, defined by the response of current parental times to previous child's outcome (see Del Bono et al 2016 [3]) . In the main body of the paper, we assume $\gamma_3^{kP} = 0$, this model is known as the value added model.

I also estimate a fixed effect model.

$$\Delta Y_{it} = \Sigma_1^k \gamma_1^k \Delta TI_{it}^k + \Sigma_1^P \Sigma_1^K \gamma_2^{kP} \Delta PTI_{it}^{kP} + \Delta \epsilon_{it} \tag{3}$$

These models rely on different assumptions. In the value added model, we assume **i)** the measurement errors in child's skills to be uncorrelated with inputs and with unobserved ability; **ii)** any omitted input is assumed to be uncorrelated with included input; **iii)** the production function is non age varying ($\gamma_3 = 0$); **iv)** the effect of inputs (observed or not) declines with age at a constant rate λ; **v)** such as the effect of unobserved abilities. In the Fixed effect model, we assume **i); ii), iii)**, assumptions **iv)** and **v)** are replaced by: **iv)** the effect of inputs (observed or not) is constant by age; **v)** such as the effect of unobserved abilities. In the Cumulative Value Added model, assumptions **iii)** and **iv)** are relaxed. For a better understanding of these assumptions, see Todd and Wolpin (2003) [20]. All models have the advantage to control for the subjectivity of the Primary Care Giver providing the BPI; captured by Y_{it-1} in the Value Added Model and cancelled out in the Fixed Effect Model.

Several specifications are estimated. In the most precise specification, three parental times are distinguished: time with at least one parent, paternal time, and time with both parents are included, maternal time is omitted and it is the reference category.

$$\Delta Y_{it} = \Sigma_1^k \gamma_1^k \Delta TI_{it}^k + \Sigma_1^K \gamma_2^{OP} \Delta PTI_{it}^{k-OP} + \Sigma_1^K \gamma_2^{k-F} \Delta PTI_{it}^{k-F} + \Sigma_1^K \gamma_2^{k-BP} \Delta PTI_{it}^{k-BP} + \Delta \epsilon_{it} \tag{4}$$

This specification aims to estimate if whom is involved or present during the activity matters for children. γ_2^{k-OP} measures the effect of one minute more with at least one parent, and γ_2^{k-F} and γ_2^{k-BP} measure the effects of spending one minute with the father only or with both parents in the activity k respectively, rather than with the mother only.

In all these models, controls Z_{it} such as individual's sex, ethnicity, age, Primary Care Giver (PCG)'s employment status, education and earnings, and the number of siblings are included. Times with step-parent and grand parents, and family structure are also controlled for in models 2, and 3. Family

structure, denoted FS_{it}, it is a set of dummies indicating if the child lives only with his mother; only with his mother who has a partner, living or not with the child; only with his father, or others (meaning that the child does not live with any of his parents). The reference category are the two parents families. Dummies indicating if the child had a father at birth or a died parent are included.

5 Results

5.1 Effect of family structure on children and parental time investments

In Table . 3, we examine whether a change in family structure affects child and parental time investments. Standard errors are clustered at the individual level. Models include individual fixed effects, and controls such as age, number of siblings, primary care giver's education, employment status and earnings. Amounts of time are standardised for a mean of 0 and a standard deviation of 1. Panel A of Table . 3 shows the estimation results for total child time investments, Panels B and C show the estimation results for parental time investments measured as time spent with at least one parent considering first accessible time (Panel B), when parent is present during the activity and second, engaged time, when the parent is involved during the activity (Panel C).

Estimations of Panel A of Table . 3 show that child's total time investments (whoever is present or involved) are not affected by family structure, children spend the same amount of time in the considered activities.

We did not expect children to change their habits after a parental separation, although, parents could be more time constrained. Therefore, is time with at least one parent affected by a change in family structure? Panels B and C show a decrease in time spent with at least one parent present in all activities, except active leisure time, especially in single mother families. Being in a single mother family leads to a decrease of 30% of a standard deviation in the time spent with at least one parent. However, this decrease in accessible time does not reflect a decrease in engaged time. Estimations results on engaged time (Panel B) reveal a poor impact of a change in family structure. Estimated coefficients are negative, but not significant even at a 10% level, except time spent in personal needs and care with at least one parent involved.

To understand better these findings, I reported the decomposition of this impact in time spent with the mother only, the father only and both parents together. Figures 4 and 5 show the decomposition of accessible and engaged parental times, respectively. One pattern comes up from these results. The custodial parent increases the time spent alone with the child, but does not manage to compensate for

the double decrease in time the child spent with his parents together, and time spent only with the non custodial parent. Looking at accessible time, time spent with the custodial parent actually decreases since she does not perfectly compensate for the decrease in time with parents together. It means that the custodial parent spends less time at home. A possible explanation is the budget constraint of single families that triggers custodial parents to increase their number of working hours to respond to the separation cost. Another explanation is the existence of complementarity effect. One parent increases (decreases) the time spent with the child if the other parent increases (decreases) his. For example, instead of going to the grocer's in family, the custodial parent may prefer to go on her own and let the child at home or with another adult.

Decomposition of time with at least one parent engaged in the activity reveals that custodial parents aim to compensate at least time that was spent with both parents, especially on activities considered as determinants for child development such as personal needs and care and education. Single father families do not show exactly the same pattern, however, there are not enough observations in this group to draw any strong conclusion.

Estimations results do not show any impact of family structure on total child time investments, neither clear effect on time spent with at least one parent involved; but results show a decrease in time with at least one parent present. Besides, the composition of accessible and engaged parental times is highly affected, time with both parents together and alone with the non custodial parent decrease in main activities. But do these changes would reflect in a lower child development ? To address this question, I consider time input production functions, and look if parental time investments matter in the production of child's cognitive and non-cognitive skills. Besides, I look if who is present or involved matters for the child.

Table . 3 – Effect of Family Structure on Child and Parental Time Investments

Panel A : Total Time (whoever was there)

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.02	0.08	−0.14	0.15	−0.09
	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)
Single Mother (step-parent)	−0.05	−0.06	0.15	0.08	−0.19
	(0.16)	(0.16)	(0.13)	(0.16)	(0.14)
Single Father	−0.01	0.14	−0.00	−0.02	−0.12
	(0.18)	(0.17)	(0.20)	(0.21)	(0.17)
Other	−0.12	0.36+	−0.29	0.18	−0.14
	(0.22)	(0.19)	(0.21)	(0.24)	(0.20)
Observations	2962	2962	2962	2962	2962
N_clust	1478.00	1478.00	1478.00	1478.00	1478.00

Panel B : Time with at least One Parent : Accessible Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.25*	−0.14+	−0.22*	0.01	−0.24*
	(0.12)	(0.08)	(0.11)	(0.10)	(0.10)
Single Mother (step-parent)	−0.27	−0.19	−0.29*	−0.21	−0.48***
	(0.17)	(0.16)	(0.15)	(0.13)	(0.14)
Single Father	−0.15	−0.58***	−0.11	0.11	−0.15
	(0.21)	(0.17)	(0.18)	(0.21)	(0.16)
Other	−0.28	−0.40+	−0.47***	−0.09	−0.44*
	(0.18)	(0.21)	(0.13)	(0.17)	(0.18)
Observations	2962	2962	2962	2962	2962
N_clust	1478.00	1478.00	1478.00	1478.00	1478.00

Panel C : Time with at least One Parent : Engaged Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.20+	−0.02	0.03	0.04	−0.05
	(0.12)	(0.09)	(0.08)	(0.09)	(0.09)
Single Mother (step-parent)	−0.22	−0.07	−0.04	0.02	−0.12
	(0.15)	(0.13)	(0.12)	(0.14)	(0.13)
Single Father	−0.20	−0.61**	−0.11	0.01	−0.15
	(0.23)	(0.19)	(0.13)	(0.23)	(0.18)
Other	−0.39*	−0.23	−0.12	−0.10	−0.31**
	(0.17)	(0.18)	(0.17)	(0.21)	(0.11)
Observations	2962	2962	2962	2962	2962
N_clust	1478.00	1478.00	1478.00	1478.00	1478.00

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Individual Fixed Effect Model. Time variables are standardised for a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included, along with death of a parent and the absence of father at birth.

Source : PSID - CDS, waves 1997, 2002 and 2007

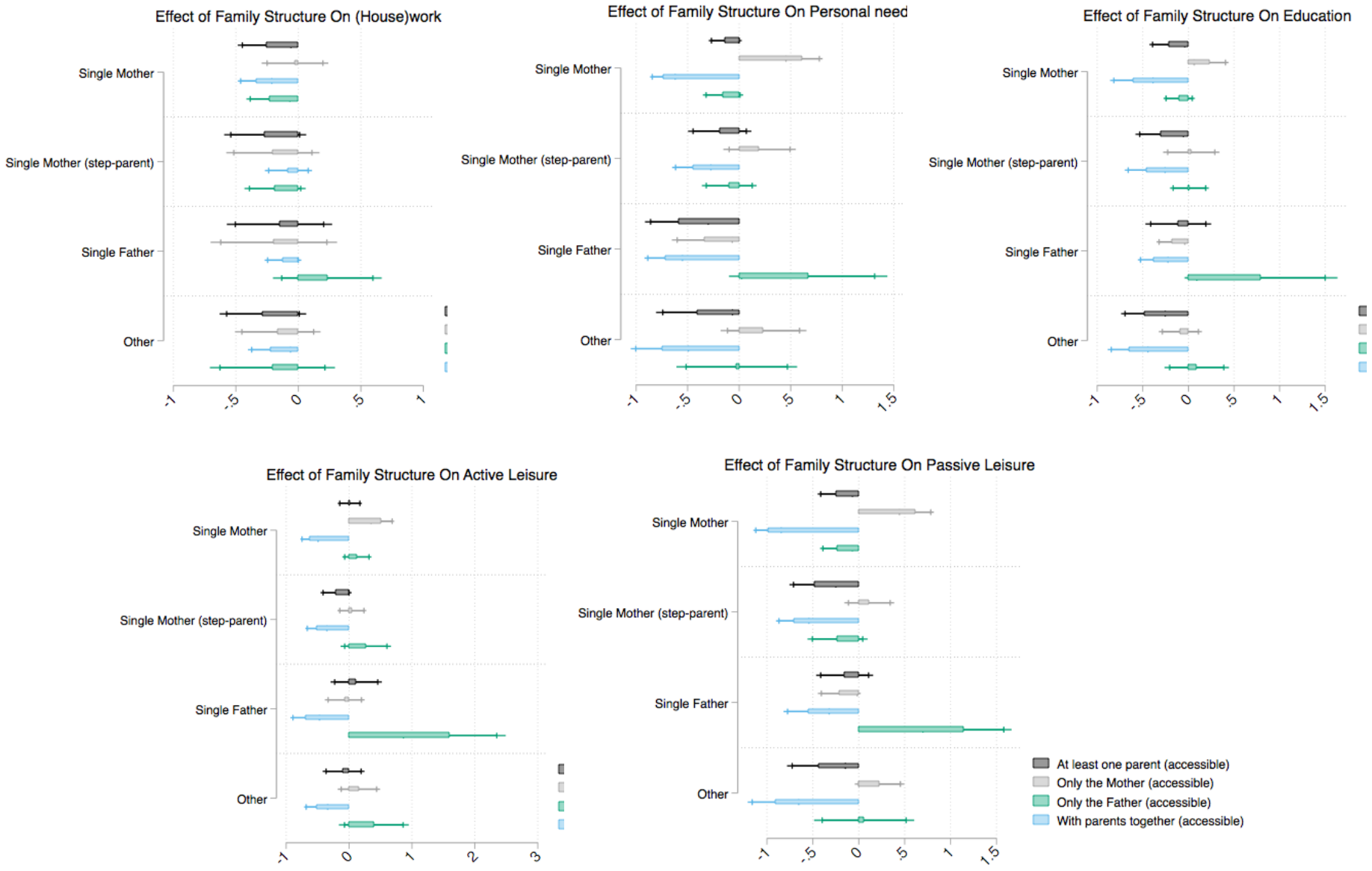


Fig. 4. Decomposition of time with at least one parent (accessible)

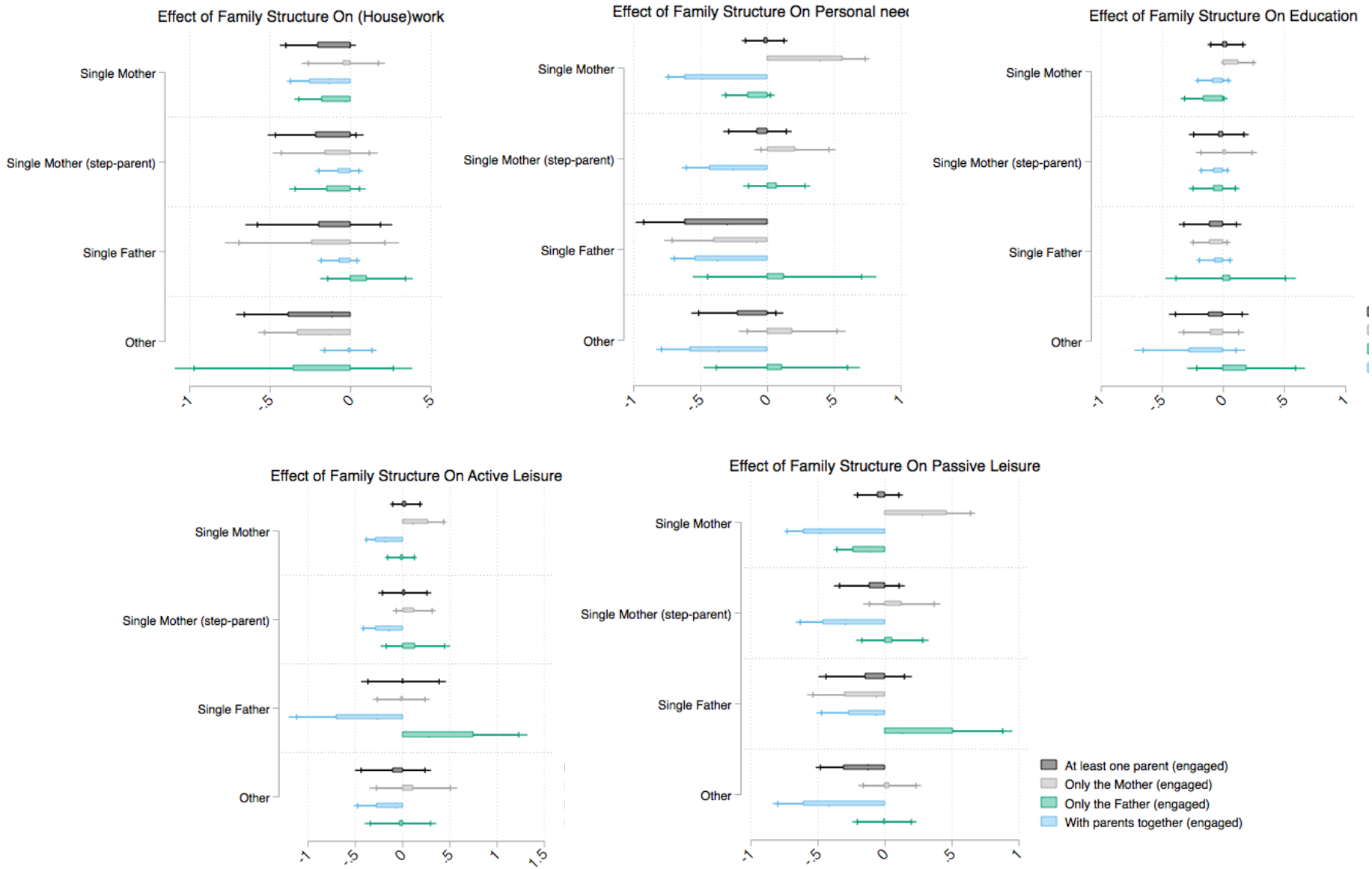


Fig. 5. Decomposition of time with at least one parent (engaged)

5.2 Time Input Production Functions and Parental Times Productivity

Using a Value Added model, Tables . 4 - . 13 present the estimations of time input production functions for cognitive and non-cognitive skills. Because the five time input measured as time spent in activities are collinear, I take time spent in personal needs and care as the omitted category. The effect of the other time input should be interpreted as relative effect to that of personal needs and care. I also consider fixed effects model in appendix and a cumulative value added model to check the robustness of the results.

Standard errors are clustered at the individual level. As mentioned earlier, models include controls such as sex, ethnicity, age, number of siblings, primary care giver's education, employment status and earnings and family structure. Amount of time are standardised for a mean of 0 and a standard deviation of 1.

I first discuss the effect of total amount of time spent in each activity. Next, I consider the effect of the presence and of the involvement of at least one parent. In Tables . 6 and . 7, I address the question of the heterogeneity of parental times investments, allowing for heterogeneity of productivity in the different parental time investments. In Tables . 8 - . 13, I allow time inputs production functions to differ across genders and across family background, respectively. Using a CVA (Cumulative Value Added) model, in Tables . 14 and . 15, I consider age varying time input production functions.

5.2.1 Time Input Production Functions

Table . 4 shows the estimated coefficients for the time input production functions considering total time (whoever was there). Active leisure and education activities are found at the top of the ranking for both cognitive and non-cognitive skills. For example, an increase of 1 standard deviation in amount of time spent in educational activities rather than in personal needs and care increase reading test score by 13% of a standard deviation. (House)Work is also found to be preferable than personal needs and care. Results suggest that personal needs and care is at the bottom of the ranking.

I perform a Wald test, the null hypothesis is rejected at a 2% level.

Results suggest that the way the child allocates his time is important in the child development, but is one hour spent in education more productive when one parent is involved or present? This question is particularly interesting for this study, since we saw earlier that accessible parental time is affected by family structure.

Table . 4 – Time Input Production Functions : Total Time (whoever was there)

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.09*	0.04+	0.05+	0.04+	0.04+
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.13*	0.09***	0.05*	0.05+	0.05+
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure	0.12*	0.08**	0.08**	0.07**	0.07**
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.04	0.04	0.01	−0.00	0.02
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

5.2.2 Does the involvement or presence of at least one parent matter?

Tables . 5 shows the estimated coefficients for the time input productions considering total time (whoever was there) and time spent with parents. Estimated coefficients on the presence or the involvement of parents capture the effect of one hour spent while the parent was present or involved during the activity. The same patterns for presence and involvement of parents emerge. In Table . 5, we can see that passive leisure are better for child development if a parent is present. This is likely to reflect the type of passive leisure the child is doing. Presence of a parent does not affect the productivity of education activities.[3] Performing a Wald test, the presence of parents is significant (at a 2% level) for the child's emotions (internalising BPI), and also for his behaviour (10% level).

Results on the effect of the involvement of parents is similar. Doing a Wald Test, the involvement of parents has also a significant effect for child's total BPI (at a 10% level).

The small effects of involvement and presence of parents could be surprising, but since we use a value added model, the models are estimated only on the second and third waves, the average age of this

[3]Although, these estimations do not take into account that the presence of parents could affect time allocation itself. Children could be more likely to do their housework rather than watching TV if their parents are at home.

sample is about 14 years old [4]. Parental investments matter but especially in early childhood, these results are not so surprising.

Nevertheless, since the composition of parental times is highly affected by family structure, we want to investigate the heterogeneity of parental times. Has one hour with the mother the same impact as one hour with the father? And moreover, is time with both parents more productive for child development?

5.2.3 Does whom is involved or present matter?

Tables . 6 and . 7 show the estimated coefficients for the time input production functions considering total time (whoever was there), time spent with at least one parent, time with father only and time with both parents. Time with at least one parent is the sum of time spent with the mother only, the father only and both parents together. Here, time with mother only is omitted and taken as the reference category. Thus, the estimated coefficients on time with father only and with both parents capture the difference in the impact of time spent with the father or both parents during the activity, and the impact of time spent with the mother only.

No strong heterogeneity among parental times emerge. Performing a Wald test, the presence of both parents or father has a significantly different impact than only mother's for reading skills (at a 6% level) and for child's behaviour (at a 11% level). The involvement of both parents or father has a significantly different impact than only mother's for reading (at a 6% level) and emotional skills (at a 10% level).

Looking more precisely at time with parents together, results suggest that it is better to be with the mother when the child is doing work or housework and to do (house)work with her rather than with the both parents for reading skills, and to do passive leisure with the mother rather than with both parents for emotional skills. This could reflect differences in the kind of housework or passive leisure. For example, it may be better for the child to watch TV with the mother only rather than with both parents, because the mother does not watch the same TV programs when the father is still involved with her. Performing a Wald test, the presence and the involvement of both parents has a significantly different impact than only mother's for reading skills (3% and 9% respectively) and for emotion (10% for involvement only).

[4] The child must have performed a test in the first wave, he was at least 3 years old for math and non-cognitive skills and 6 years old for reading, thus he is at least 8 and 11 years old in the second wave respectively.

Table . 5 – Time Input Production Functions : Effect of the presence/involvement of at least one parent

Panel A : Accessible Time

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.07+	0.04	0.05+	0.04	0.07+
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.12+	0.08**	0.06*	0.05+	0.06*
	(0.07)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure	0.11*	0.09**	0.09**	0.08**	0.08**
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.06	0.06+	−0.03	−0.04	−0.02
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	0.00	−0.01	0.01	−0.03
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	0.03	0.03	−0.02	−0.00	−0.04+
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
Active Leisure (with at least one parent)	0.02	−0.01	−0.01	−0.01	−0.01
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.03	−0.03	0.07**	0.07**	0.06*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Panel B : Engaged Time

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.07+	0.05	0.04	0.02	0.05
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.13*	0.09**	0.05+	0.04+	0.05+
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure	0.12*	0.08**	0.09**	0.08**	0.08**
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.05	0.04	−0.01	−0.02	0.00
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	−0.01	0.02	0.04	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with at least one parent)	−0.01	−0.01	−0.01	−0.01	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	0.00	−0.01	−0.03	−0.03	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with at least one parent)	−0.04	−0.00	0.05*	0.04+	0.05*
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Results also suggest that it is better to be with the mother when the child is doing (house)work and (slightly) to do (house)work with her rather than with the father for non-cognitive skills. On the contrary, it seems to be better to do education activities with the father or when he is present for non-cognitive skills, this could reflect different behaviours and attitudes among parents regarding to educational activities. Performing a Wald test, father's involvement and presence seem to have a significant different effect from mother's involvements or presence for emotional skills.

Results suggest that time spent with both parents, or father have slightly different impact than time spent with the mother. Nevertheless, since the estimated effect of at least one parent present or involved is small, it is unsurprising to find small evidence of heterogeneity. Again, this only applies to adolescents. The data do not enable us to see if parental times investments have different effect in early childhood.

Until now, we have considered a common time input production function for all children. In the next section, we will allow differences in the time input production function across gender, PCG's education and age.

Table . 6 – Time Input Production Functions : Does whom is present matter ? (Accessible Time)

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.08+	0.05	0.05+	0.04	0.07+
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.12+	0.08**	0.06*	0.05+	0.06*
	(0.07)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure	0.11*	0.09***	0.09**	0.08**	0.08**
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.06	0.06+	−0.03	−0.05	−0.02
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.05+	0.02	0.00	0.02	−0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	0.00	0.04	−0.02	0.01	−0.06
	(0.05)	(0.04)	(0.03)	(0.03)	(0.04)
Active Leisure (with at least one parent)	−0.02	−0.03	0.01	−0.00	0.01
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
Passive Leisure (with at least one parent)	−0.00	−0.02	0.08*	0.07+	0.08*
	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)
(House)Work (with parents together)	−0.05*	−0.01	−0.01	−0.00	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Education (with parents together)	0.04	−0.01	−0.02	−0.03	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure (with parents together)	0.06*	0.02	−0.00	0.01	−0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (with parents together)	−0.04	−0.01	0.00	0.02	−0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with father only)	0.01	−0.05*	−0.04+	−0.02	−0.05*
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with father only)	0.02	0.02	0.03	0.03	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with father only)	−0.00	0.03	−0.04	−0.02	−0.04+
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Passive Leisure (with father only)	−0.02	−0.00	−0.01	−0.02	−0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table . 7 – Time Input Production Functions : Does whom is involved matter ? (Engaged Time)

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.08+	0.05+	0.04	0.02	0.06+
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.13*	0.09**	0.05+	0.05+	0.04
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure	0.12*	0.09**	0.09***	0.08**	0.08**
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.05	0.04	−0.01	−0.01	0.01
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.05*	0.00	0.03	0.04	0.00
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	−0.02	−0.03	−0.03	0.00	−0.05+
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure (with at least one parent)	−0.01	−0.04	−0.04	−0.03	−0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.03	0.00	0.07*	0.04	0.08**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with parents together)	−0.05**	0.00	−0.01	−0.00	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with parents together)	−0.01	0.04	0.01	−0.02	0.03+
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
Active Leisure (with parents together)	0.05+	0.02	0.02	0.01	0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (with parents together)	−0.03	−0.01	−0.02	0.01	−0.05+
	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)
(House)Work (with father only)	−0.00	−0.04*	−0.03	−0.02	−0.03
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with father only)	0.03	0.02	0.03	0.00	0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with father only)	−0.04	0.03	−0.01	−0.01	0.00
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with father only)	0.01	0.01	−0.04	−0.02	−0.03
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

5.2.4 Heterogeneity of Time Input Production Functions

In Tables . 8 and . 13, I allow time input investments to vary across gender and PCG's education respectively. As in the previous section, time input production functions include total time (whoever was there), time spent with at least one parent, time with father only and time with both parents. In the following tables, the focus is on time when the parents are involved in the activity. The estimated coefficients for interaction terms are reported, it catches the possible differences in the effect of time input for girls, and more highly educated parents. As mentioned before, the estimated coefficients on time with father only and with both parents capture the effect of one hour spent with the father or both parents during the activity, rather than with the mother only.

Child's gender

Estimations results in Table . 8 suggest that doing active leisure rather than personal needs and care affect less girls' non-cognitive skills than boys' one. There is no evidence of differences in the effect of time with at least one parent involved, and no much evidence of the effect of involvement of fathers. The effect of the involvement of both parents rather than mother only seem to benefit more to girls' reading skills when they are doing educational activities, and to her math skills when they are doing (house)work and to boys when they're doing passive leisure. The effect of the involvement of father rather than mother seem to benefit more to girls' reading skills when they are doing (house)work and educational activities.

I perform a Wald Test to test the hypothesis that the vector of estimated effects of time input production functions of girls is the same than boys' one (testing that the vector of interaction terms is jointly equal to 0). We reject the null hypothesis for emotional skills considering total allocation of time. This suggest that girls' non-cognitive skills may respond differently than boys to the total amount of time in each activity. The results do not suggest differences in the effects of parental times investments across genders.

The same pattern emerge when we consider presence of parents. Nevertheless, girls' reading skills also seem to respond differently to the presence of parents.

Child's Family Background

In this section we wonder if time input production functions are different across family background.

I have considered earnings and education to capture family background, taken the variables as continuous or looking at the effect of being above or below the median PCG's earnings or PCG's education. Average PCG's education is around 13 years, the median is also 13, from 0 to 17 (Top 10%). Parents are considered as more highly educated when their education level is greater that 13 years, 45% of children of the sample have a more highly PCG. Median log earnings is around 10, log of earnings goes from 2 to 12.6.

For the sake of brevity, I only have reported the results on more highly educated PCG. Again, I only report the results on parents involvement.

Results suggest that children's non-cognitive skills whose PCG is more highly educated respond more to active leisure and to education; their reading skills respond more to (house)work. This could reflect different kind of active leisure or educational activities. More highly educated parents may increase their children's investments in active leisure that plays a greater role in child's non-cognitive development; also, their children may not read the same books as children whose PCG is not highly educated. Their behaviour responds more positively to passive leisure when at least one parent is involved. This could reflect the type of leisure they are doing.

Math skills respond more to the involvement of fathers rather than mothers when the PCG is more highly educated. This could reflect differences in parent's skills, since the husband is generally higher educated than the wife in American households.

The main finding is that their cognitive skills respond more positively to the involvement of both parents in education rather than mother only, results suggest the opposite effect on non-cognitive skills. This last finding suggests a trade-off between cognitive and non-cognitive skills when both parents are involved in education activities.

No such evidence shows up when we look at education as a continuum, the effect of PCG's education is not linear. Also, there is poor evidence of an effect of PCG's earnings.

Performing a Wald Test to test if children with more highly educated PCG respond differently to time inputs, we reject the null hypothesis (equality of the coefficients) for externalising BPI, Total BPI, and reading skills. Parental time inputs appear to make the difference. Presence does not have different effect if the parents are more highly educated.

These results suggest that even adolescents benefit more from time spent with parents who are more highly educated. This does not seem to come from differences in earnings since we do not find an evidence of differences in the effects of time input across earnings. This could reflect differences in the type of activities. For example, listening music or going to the theatre may not have the same effect than more popular leisure. Parenting style and parents' skills are also very likely to explain these differences.

Time input production functions vary across gender and family background. Results suggest that girls non-cognitive skills seem to be more sensitive to time allocation in total. Nevertheless, they do respond in the same way to parental time investments. There is no evidence of an own-gender effect where time with fathers benefit more to boys and time with mothers benefit more to girls.

Time input production functions vary also according to PCG's education. Involvement of parents benefit more to children when the PCG is more highly, especially for reading and for externalising BPI. The first effect may reflect differences in verbal skills of parents. The second one may simply reflect differences in parenting style.

We also want to address for the differences of time input production functions across age. According to Del Boca et al (2017) [2], parental time investments matter in childhood but own investments matter in adolescence. When we interact time inputs with age, no evidences of this effect appear, but we still have a sample where mean age is 14. Thus we use a CVA model to address this question. As mentioned earlier, it relaxes the assumptions **iii** and **iv** of the Value Added Model, we allow for past time input to have different effect by age.

Table . 8 – Time Input Production Functions : Does gender matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
Female=1 × (House)Work	0.09	0.04	0.06	0.02	0.08
	(0.08)	(0.06)	(0.06)	(0.06)	(0.07)
Female=1 × Education	0.05	−0.04	−0.08	−0.08	−0.06
	(0.12)	(0.06)	(0.05)	(0.05)	(0.05)
Female=1 × Active Leisure	0.15+	0.02	−0.15**	−0.13*	−0.14**
	(0.09)	(0.05)	(0.05)	(0.05)	(0.05)
Female=1 × Passive Leisure	0.06	0.04	−0.07	−0.09	−0.03
	(0.09)	(0.05)	(0.06)	(0.06)	(0.06)
Female=1 × (House)Work (with at least one parent)	−0.08	−0.05	−0.00	0.03	−0.03
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Female=1 × Education (with at least one parent)	0.04	−0.07	0.02	0.01	0.04
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Female=1 × Active Leisure (with at least one parent)	−0.03	0.03	0.07	0.04	0.05
	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)
Female=1 × Passive Leisure (with at least one parent)	0.02	0.04	0.04	0.10+	−0.03
	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)
Female=1 × (House)Work (with parents together)	−0.00	0.07+	0.00	0.00	−0.01
	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)
Female=1 × Education (with parents together)	−0.12*	−0.05	0.03	0.05	−0.03
	(0.05)	(0.06)	(0.04)	(0.04)	(0.04)
Female=1 × Active Leisure (with parents together)	0.03	−0.02	−0.06	−0.06	−0.03
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Female=1 × Passive Leisure (with parents together)	−0.00	−0.08+	0.02	−0.00	0.06
	(0.08)	(0.04)	(0.05)	(0.05)	(0.05)
Female=1 × (House)Work (with father only)	0.14+	0.01	−0.00	−0.03	0.02
	(0.08)	(0.05)	(0.04)	(0.05)	(0.05)
Female=1 × Education (with father only)	0.06+	0.01	−0.06	−0.05	−0.06
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Female=1 × Active Leisure (with father only)	0.06	0.05	−0.00	0.02	−0.02
	(0.06)	(0.05)	(0.05)	(0.05)	(0.06)
Female=1 × Passive Leisure (with father only)	−0.02	−0.07	−0.04	−0.07	0.00
	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table . 9 – Time Input Production Functions : Does Primary Care Giver's Education matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
Higher_educated=1 × (House)Work	0.18*	0.00	0.07	0.03	0.09
	(0.08)	(0.06)	(0.06)	(0.06)	(0.07)
Higher_educated=1 × Education	0.16	0.02	0.13*	0.13*	0.10+
	(0.12)	(0.06)	(0.06)	(0.05)	(0.06)
Higher_educated=1 × Active Leisure	0.14	0.02	0.13*	0.10+	0.13*
	(0.10)	(0.05)	(0.06)	(0.06)	(0.06)
Higher_educated=1 × Passive Leisure	0.09	−0.00	0.07	0.02	0.11
	(0.10)	(0.06)	(0.06)	(0.06)	(0.07)
Higher_educated=1 × (House)Work (with at least one parent)	−0.10*	−0.02	0.02	0.01	0.01
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Higher_educated=1 × Education (with at least one parent)	−0.10+	−0.06	−0.01	−0.02	0.03
	(0.06)	(0.05)	(0.05)	(0.05)	(0.06)
Higher_educated=1 × Active Leisure (with at least one parent)	0.01	0.03	−0.08	−0.11+	−0.02
	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)
Higher_educated=1 × Passive Leisure (with at least one parent)	−0.07	−0.01	0.09	0.13*	0.03
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
Higher_educated=1 × (House)Work (with parents together)	−0.01	0.03	−0.07+	−0.07+	−0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Higher_educated=1 × Education (with parents together)	0.08**	0.12*	−0.07*	−0.04	−0.08*
	(0.03)	(0.05)	(0.03)	(0.04)	(0.04)
Higher_educated=1 × Active Leisure (with parents together)	−0.02	−0.01	0.08	0.08	0.06
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Higher_educated=1 × Passive Leisure (with parents together)	0.15*	0.03	−0.00	−0.02	0.02
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)
Higher_educated=1 × (House)Work (with father only)	0.10+	0.02	−0.02	−0.01	−0.00
	(0.06)	(0.04)	(0.04)	(0.04)	(0.05)
Higher_educated=1 × Education (with father only)	0.02	0.08*	0.07	0.06	0.07
	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)
Higher_educated=1 × Active Leisure (with father only)	−0.00	−0.04	0.03	−0.01	0.06
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)
Higher_educated=1 × Passive Leisure (with father only)	−0.01	−0.00	−0.06	−0.05	−0.05
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table . 10 – Time Input Production Functions : Does Primary Care Giver's Education matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
Family_Structure=0 × (House)Work	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × (House)Work	−0.10	−0.07	0.03	0.00	0.06
	(0.09)	(0.07)	(0.07)	(0.07)	(0.07)
Family_Structure=2 × (House)Work	−0.11	0.19*	0.06	−0.03	0.10
	(0.12)	(0.09)	(0.12)	(0.12)	(0.13)
Family_Structure=3 × (House)Work	−0.21*	−0.07	0.09	0.09	0.06
	(0.10)	(0.11)	(0.15)	(0.15)	(0.14)
Family_Structure=4 × (House)Work	−0.18	−0.28	−0.01	0.05	−0.12
	(0.13)	(0.17)	(0.21)	(0.22)	(0.20)
Family_Structure=0 × Education	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Education	−0.14	−0.07	0.04	0.04	0.04
	(0.12)	(0.07)	(0.07)	(0.07)	(0.07)
Family_Structure=2 × Education	−0.27+	0.04	0.03	0.01	0.00
	(0.14)	(0.11)	(0.13)	(0.13)	(0.13)
Family_Structure=3 × Education	−0.04	0.01	0.16	0.22	0.00
	(0.14)	(0.13)	(0.21)	(0.21)	(0.19)
Family_Structure=4 × Education	−0.23	0.20+	−0.00	−0.09	0.18
	(0.18)	(0.11)	(0.14)	(0.16)	(0.13)
Family_Structure=0 × Active Leisure	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Active Leisure	0.01	0.01	−0.03	−0.02	−0.03
	(0.10)	(0.07)	(0.06)	(0.07)	(0.06)
Family_Structure=2 × Active Leisure	−0.25*	0.07	0.13	0.13	0.11
	(0.12)	(0.10)	(0.11)	(0.12)	(0.12)
Family_Structure=3 × Active Leisure	−0.05	−0.10	0.20	0.31*	0.03
	(0.10)	(0.11)	(0.15)	(0.15)	(0.14)
Family_Structure=4 × Active Leisure	−0.23	−0.22+	−0.09	−0.12	0.01
	(0.15)	(0.12)	(0.14)	(0.14)	(0.14)
Family_Structure=0 × Passive Leisure	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Passive Leisure	−0.06	−0.02	0.09	0.05	0.12+
	(0.11)	(0.07)	(0.07)	(0.07)	(0.07)
Family_Structure=2 × Passive Leisure	−0.21+	0.20*	0.13	0.07	0.18
	(0.11)	(0.09)	(0.12)	(0.13)	(0.12)
Family_Structure=3 × Passive Leisure	−0.17	−0.16	0.31	0.30	0.14
	(0.13)	(0.14)	(0.26)	(0.24)	(0.25)
Family_Structure=4 × Passive Leisure	−0.16	0.12	−0.07	−0.13	0.08
	(0.15)	(0.12)	(0.16)	(0.17)	(0.16)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the

Table . 11 – Time Input Production Functions : Does Primary Care Giver's Education matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
Family_Structure=0 × (House)Work (with mother only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × (House)Work (with mother only)	0.02	0.05	0.04	0.08+	−0.01
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)
Family_Structure=2 × (House)Work (with mother only)	−0.01	0.00	0.07	0.15+	0.01
	(0.08)	(0.09)	(0.08)	(0.08)	(0.10)
Family_Structure=3 × (House)Work (with mother only)	0.02	0.13*	0.25***	0.21**	0.22**
	(0.05)	(0.05)	(0.08)	(0.08)	(0.07)
Family_Structure=4 × (House)Work (with mother only)	−0.21	−0.29	−0.47+	−0.56*	−0.24
	(0.22)	(0.22)	(0.27)	(0.27)	(0.23)
Family_Structure=0 × Education (with mother only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Education (with mother only)	−0.03	0.03	−0.00	−0.03	0.01
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Family_Structure=2 × Education (with mother only)	−0.15***	−0.04	−0.04	0.00	−0.09
	(0.05)	(0.04)	(0.06)	(0.05)	(0.07)
Family_Structure=3 × Education (with mother only)	1.01	−0.85	2.96**	2.80*	3.34**
	(0.86)	(1.06)	(1.13)	(1.15)	(1.07)
Family_Structure=4 × Education (with mother only)	−9.80	−0.07	0.48*	0.49**	0.33
	(9.70)	(0.11)	(0.22)	(0.19)	(0.23)
Family_Structure=0 × Active Leisure (with mother only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Active Leisure (with mother only)	−0.01	−0.04	0.05	0.08*	0.01
	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)
Family_Structure=2 × Active Leisure (with mother only)	0.04	−0.33**	−0.15	−0.10	−0.24
	(0.13)	(0.11)	(0.13)	(0.15)	(0.15)
Family_Structure=3 × Active Leisure (with mother only)	−0.04	−0.07	0.40*	0.45**	0.30
	(0.08)	(0.17)	(0.17)	(0.15)	(0.18)
Family_Structure=4 × Active Leisure (with mother only)	0.15+	−0.23*	0.11	0.17	0.04
	(0.08)	(0.10)	(0.12)	(0.13)	(0.12)
Family_Structure=0 × Passive Leisure (with mother only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Passive Leisure (with mother only)	−0.04	−0.05	−0.06	−0.06	−0.07
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)
Family_Structure=2 × Passive Leisure (with mother only)	−0.07	−0.09	−0.00	0.01	0.00
	(0.09)	(0.07)	(0.13)	(0.12)	(0.14)
Family_Structure=3 × Passive Leisure (with mother only)	−0.17	−0.15	−0.45	−0.50	−0.29
	(0.12)	(0.19)	(0.35)	(0.33)	(0.36)
Family_Structure=4 × Passive Leisure (with mother only)	−1.07*	−0.33	0.05	0.17	−0.23
	(0.49)	(0.33)	(0.38)	(0.42)	(0.30)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent

Table . 12 – Time Input Production Functions : Does Primary Care Giver's Education matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
Family_Structure=0 × (House)Work (with parents together)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × (House)Work (with parents together)	0.01	0.08*	−0.05	−0.07	−0.01
	(0.04)	(0.03)	(0.05)	(0.05)	(0.04)
Family_Structure=2 × (House)Work (with parents together)	0.01	0.02	−0.06	−0.03	−0.09
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)
Family_Structure=3 × (House)Work (with parents together)	−0.11	0.01	−0.06	0.21*	−0.38***
	(0.21)	(0.12)	(0.11)	(0.11)	(0.10)
Family_Structure=4 × (House)Work (with parents together)	1.14+	1.56	−1.38+	−1.38+	−0.73
	(0.67)	(1.26)	(0.73)	(0.83)	(0.58)
Family_Structure=0 × Education (with parents together)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Education (with parents together)	−2.93	−0.12*	−0.18***	−0.27***	−0.06
	(2.56)	(0.05)	(0.05)	(0.07)	(0.04)
Family_Structure=2 × Education (with parents together)	2.04	−0.12*	0.22+	0.15	0.28**
	(2.76)	(0.05)	(0.13)	(0.13)	(0.09)
Family_Structure=3 × Education (with parents together)	0.26*	−0.22	−1.63***	−0.92***	−2.24***
	(0.12)	(0.18)	(0.25)	(0.23)	(0.23)
Family_Structure=4 × Education (with parents together)	31.09	14.32+	−7.30	−5.56	−7.28
	(32.33)	(8.08)	(8.49)	(8.90)	(7.35)
Family_Structure=0 × Active Leisure (with parents together)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Active Leisure (with parents together)	−0.38***	−0.28*	0.17	0.24	0.06
	(0.11)	(0.11)	(0.16)	(0.20)	(0.11)
Family_Structure=2 × Active Leisure (with parents together)	0.03	−0.53***	−0.40***	−0.32	−0.48**
	(0.11)	(0.14)	(0.12)	(0.21)	(0.17)
Family_Structure=3 × Active Leisure (with parents together)	−0.20	0.18**	0.26*	0.20+	0.25**
	(0.22)	(0.06)	(0.12)	(0.11)	(0.10)
Family_Structure=4 × Active Leisure (with parents together)	−0.92***	0.24	0.31	0.17	0.37
	(0.24)	(0.99)	(0.32)	(0.39)	(0.30)
Family_Structure=0 × Passive Leisure (with parents together)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Passive Leisure (with parents together)	0.32*	0.44**	−0.03	−0.05	0.04
	(0.13)	(0.14)	(0.10)	(0.12)	(0.07)
Family_Structure=2 × Passive Leisure (with parents together)	−0.14	−0.13	−0.27+	−0.22	−0.25*
	(0.17)	(0.10)	(0.14)	(0.17)	(0.12)
Family_Structure=3 × Passive Leisure (with parents together)	0.12+	0.08	0.09	0.08	0.15+
	(0.07)	(0.06)	(0.09)	(0.09)	(0.08)
Family_Structure=4 × Passive Leisure (with parents together)	−1.20	−5.87*	4.69+	4.10	3.95+
	(2.09)	(2.41)	(2.64)	(2.80)	(2.04)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Table . 13 – Time Input Production Functions : Does Primary Care Giver's Education matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
Family_Structure=0 × (House)Work (with father only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × (House)Work (with father only)	0.25	0.01	−0.03	−0.01	0.00
	(0.28)	(0.12)	(0.07)	(0.09)	(0.06)
Family_Structure=2 × (House)Work (with father only)	−0.12	−0.21*	0.09	0.12	0.07
	(0.12)	(0.10)	(0.11)	(0.14)	(0.09)
Family_Structure=3 × (House)Work (with father only)	−0.09	0.09	−0.06	−0.04	−0.08
	(0.06)	(0.07)	(0.08)	(0.07)	(0.10)
Family_Structure=4 × (House)Work (with father only)	−0.24	0.31	0.26*	0.23*	0.30+
	(0.20)	(0.76)	(0.13)	(0.11)	(0.17)
Family_Structure=0 × Education (with father only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Education (with father only)	0.01	−0.13	−0.06	−0.08	−0.01
	(0.06)	(0.15)	(0.08)	(0.10)	(0.05)
Family_Structure=2 × Education (with father only)	−0.68*	−0.98***	1.45**	1.75***	0.66
	(0.33)	(0.29)	(0.48)	(0.43)	(0.46)
Family_Structure=3 × Education (with father only)	−0.11*	−0.04	−0.07	−0.09	−0.05
	(0.04)	(0.05)	(0.10)	(0.08)	(0.10)
Family_Structure=4 × Education (with father only)	0.88	−2.47	0.54*	0.52*	0.48+
	(1.44)	(4.25)	(0.23)	(0.21)	(0.29)
Family_Structure=0 × Active Leisure (with father only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Active Leisure (with father only)	−0.19	−0.07	−0.06	−0.08	−0.03
	(0.11)	(0.07)	(0.06)	(0.06)	(0.06)
Family_Structure=2 × Active Leisure (with father only)	−0.19	0.24+	0.25	0.20	0.19
	(0.13)	(0.13)	(0.21)	(0.20)	(0.11)
Family_Structure=3 × Active Leisure (with father only)	−0.08	−0.01	0.07	0.03	0.11*
	(0.05)	(0.04)	(0.06)	(0.06)	(0.06)
Family_Structure=4 × Active Leisure (with father only)	0.00	−0.03	0.30+	0.58*	−0.18
	(.)	(0.83)	(0.17)	(0.28)	(0.25)
Family_Structure=0 × Passive Leisure (with father only)	0.00	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)	(.)
Family_Structure=1 × Passive Leisure (with father only)	0.10	−0.03	0.11	0.13	0.07
	(0.08)	(0.12)	(0.09)	(0.10)	(0.09)
Family_Structure=2 × Passive Leisure (with father only)	0.10	−0.04	−0.12	−0.19*	0.00
	(0.08)	(0.08)	(0.08)	(0.09)	(0.06)
Family_Structure=3 × Passive Leisure (with father only)	−0.00	−0.07+	0.05	0.14+	−0.01
	(0.04)	(0.04)	(0.08)	(0.08)	(0.07)
Family_Structure=4 × Passive Leisure (with father only)	0.07	0.12	−1.59**	−1.51**	−1.44*
	(0.34)	(0.51)	(0.57)	(0.50)	(0.72)
Observations	1349	1669	1761	1782	1788
N_clust	1235.00	1349.00	1423.00	1439.00	1443.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent

5.2.5 Cumulative Value Added Time Input Production Functions

As mentioned earlier, the CVA model relies on the following assumptions: **i)** the measurement errors in child's skills to be uncorrelated with inputs and with unobserved ability; **ii)** any omitted input is assumed to be uncorrelated with included input; **v)** the effect of unobserved ability declines with age at a constant rate λ. It allows for age varying time input production functions, the effect of time with parents or own time investments are allowed to vary by age and the effect could decline at a non constant rate.

For the sake of brevity, time input production functions include total time (whoever was there) and time spent with at least one parent at time t and $t-1$. Estimated coefficients on the contemporaneous presence or the involvement of parents capture the same effect as explained before. Estimated coefficients on the lagged inputs measure the effect of an increase of about 1 standard deviation in the activity 5 years ago on the current input. In this sample, the child was on average 9 years old five years ago.

Table . 14 shows the results for accessible time. Coefficients on current time inputs are not much affected. Presence of parents in earlier childhood does not seem to have a persistent effect. Results suggest that passive leisures of previous period are slightly worse for child development if a parent is present.

Table . 15 shows the results for engaged time. Coefficients on contemporaneous time inputs are not affected by the introduction of lagged time inputs. Previous own child time inputs do not seem to affect child's current test score. However, results suggest that past educational activities with one parent involved benefit to the child's behaviour.

There is no evidence of heterogeneity in parental time investments in this specification. Estimations results suggest that early parental time inputs are more productive ($\gamma_3 > \gamma_2$) and persistent ($\lambda > 0$) for children behaviour. I do not find an evidence of a feedback effect.

Performing a Wald Test to test the null hypothesis that coefficients of allocation of time are jointly equal to zero, results suggest that child's time allocation matters for all outcomes, and involvement of parents matters for reading (at a 9% level), Total BPI (at a 6% level) and externalising BPI; the presence of parents matters for all outcomes except math skills.

Heterogeneity of parental times is also investigated in the CVA model. The null hypothesis assumes that time with father and time with both parents together have the same impact than maternal time. We reject the null hypothesis for reading skills at a 5% level both for involvement and presence of parents.

Del Boca et al (2017) [2] test this model's assumptions. To test assumption **i)**, they use an analytic

correction formula and do not find evidence of any bias caused by measurement errors. To test assumption **ii)**, they add school inputs, early childhood inputs and children health shocks, and results are not affected.

Table . 14 – Cumulative Value Added Time Input Production Functions

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.08+	0.05+	0.05+	0.04	0.06+
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.12+	0.09**	0.07*	0.05+	0.07*
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure	0.12*	0.10***	0.09**	0.09**	0.08**
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.06	0.07*	−0.03	−0.04	−0.01
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (t-1)	−0.00	0.01	−0.04	−0.00	−0.09+
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Education (t-1)	−0.05	−0.01	−0.00	−0.03	0.02
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure (t-1)	−0.07*	−0.00	−0.02	−0.03	−0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (t-1)	−0.03	−0.01	0.05*	0.04+	0.05+
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	−0.01	−0.01	0.01	−0.03
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	0.03	0.03	−0.03	−0.00	−0.05*
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
Active Leisure (with at least one parent)	0.02	−0.01	−0.01	−0.01	−0.01
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.03	−0.03	0.07**	0.07**	0.06*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent) (t-1)	−0.01	−0.04	0.03	−0.00	0.08
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Education (with at least one parent) (t-1)	0.01	0.02	0.03	0.03	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent) (t-1)	0.05	0.03	0.04	0.04	0.03
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent) (t-1)	−0.01	−0.03	−0.07*	−0.05+	−0.07*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Observations	1329	1618	1699	1719	1721
N_clust	1215.00	1298.00	1361.00	1376.00	1376.00

Cumulative Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table . 15 – Cumulative Value Added Time Input Production Functions (engaged time)

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.07+	0.05+	0.04	0.03	0.05
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.13*	0.10***	0.05*	0.05+	0.05+
	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure	0.12*	0.10***	0.10***	0.09***	0.08**
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.05	0.05+	−0.00	−0.01	0.01
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (t-1)	0.01	−0.02	−0.03	−0.02	−0.05
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Education (t-1)	−0.04	−0.00	0.00	−0.02	0.03
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure (t-1)	−0.06+	0.01	−0.01	−0.02	0.01
	(0.04)	(0.02)	(0.03)	(0.03)	(0.03)
Passive Leisure (t-1)	−0.05+	−0.03	0.02	0.02	0.02
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
(House)Work (with at least one parent)	0.04*	−0.01	0.02	0.03	−0.01
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	−0.01	−0.02	−0.01	−0.00	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	−0.00	−0.02	−0.04+	−0.04+	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with at least one parent)	−0.04	0.00	0.05*	0.04+	0.05*
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
(House)Work (with at least one parent) (t-1)	−0.02	0.01	0.02	0.03	0.03
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Education (with at least one parent) (t-1)	−0.03	−0.00	0.04*	0.05**	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent) (t-1)	0.03	0.00	0.03	0.04+	0.00
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with at least one parent) (t-1)	0.02	−0.00	−0.01	−0.00	−0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	1329	1618	1699	1719	1721
N_clust	1215.00	1298.00	1361.00	1376.00	1376.00

Cumulative Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

5.3 Robustness Checks

5.3.1 Attrition

Table . 16 shows the number of observations in each wave and when they leave the sample. The balanced panel includes 949 observations. No Attrition (A_123) means that the child is observed in the three waves. A_1, A_2 and A_3 means that the child was present only in the first, second and third wave, respectively. A_12 means that he leaves the sample in the third wave; A_13 that he was observed only in the first and the third waves; A_23 that he was observed only in the second and third waves.

Table . 16 – Attrition across waves

	wave		
	1997	2002	2007
A_123	949	949	949
A_1	525		
A_12	1040	1040	
A_13	140		140
A_2		24	
A_3			32
A_23		121	121
Total	2654	2134	1242

Table . 17 shows the summary statistics for different groups that leave the sample or not, when several waves are available, the first wave is considered. Children observed in all waves are younger, are more likely to live with their two parents, to be White and to have a primary care giver who is a housewife and earn less.

Table . 18 shows how attrition is explained, using logit regressions. Results are in odd ratio. The probability to leave the sample is higher when the child is older, especially for the attrition on the third wave, and also when the PCG is a housewife. Family structure explains the attrition in the second wave.

Attrition is difficult to address in this case, because it is explained by time varying variables, and we don't know how these variables change in the second wave. For example, children who live with their mother in the first wave could leave the sample because they live with their single mother or because the mother met someone and move in with him. An Inverse Probability Weighting can not be used here, because attrition is explained mainly by time-varying variables. Also, looking at age, we could explain attrition by year of birth, but here we do not want to over-weight individuals who are older because they are not children any more, and moreover, attrition concerns all individuals that are more than 19 years old. To check if attrition affect the results, the model is run on the balanced sample.

Table . 17 – Attrition : Descriptive statistics

	(1) No Attrition mean	(2) All attrition mean	(3) A_1 mean	(4) A_12 mean	(5) A_13 mean	(6) A_23 mean
Age	3.98	11.48	7.77	8.70	4.35	9.96
Two Parents	0.73	0.56	0.50	0.64	0.64	0.46
Single Mother	0.22	0.28	0.33	0.23	0.22	0.41
Single Mother (step-parent)	0.02	0.09	0.08	0.06	0.05	0.06
Single Father	0.01	0.03	0.02	0.02	0.04	0.02
Other	0.02	0.05	0.07	0.04	0.04	0.05
White	0.56	0.35	0.43	0.50	0.47	0.01
African american	0.32	0.39	0.45	0.37	0.41	0.61
Hispanic	0.08	0.07	0.05	0.08	0.07	0.07
Asian Pacific	0.01	0.02	0.02	0.02	0.04	0.05
American Indian	0.00	0.01	0.01	0.00	0.00	0.00
Other	0.03	0.04	0.04	0.04	0.01	0.05
Inap	0.00	0.00	0.00	0.00	0.00	0.00
PCG - Worker	0.62	0.67	0.57	0.66	0.67	0.73
PCG - Looking for work	0.06	0.07	0.10	0.07	0.12	0.07
PCG - Retired	0.00	0.00	0.00	0.00	0.00	0.00
PCG - Disabled	0.00	0.00	0.00	0.00	0.00	0.00
PCG - Housewife	0.27	0.22	0.29	0.23	0.18	0.17
PCG - Student	0.05	0.02	0.03	0.03	0.02	0.00
PCG - Other	0.01	0.01	0.02	0.01	0.01	0.03
Female	0.48	0.49	0.45	0.51	0.48	0.57
Earnings	9.43	9.74	9.51	9.49	9.54	9.71
Observations	905	1694	520	1031	138	153

Results are very similar for the balanced panel. Some coefficients are not significant any more, since we lose in precision having a smaller sample, but the magnitude is quite close. Results are shown in Tables A15 to A18.

5.3.2 Outliers

Individuals with a high variation in their cognitive or non-cognitive skills are excluded, we compute the variation in the cognitive and non cognitive skills between 2 consecutive waves, and exclude the 2% who have the lowest variation, and the 2% who have the highest variation.

Tables A19 to A21 show the results when outliers are excluded, results are similar. There are few changes when we look at the effect of involvement of parents in leisure: the positive effect of the involvement of parents in passive leisure is not significant any more, and the involvement of parents in active leisure is still negative but becomes significant.

Table . 18 – Attrition - Logit regression

	(1) Attrition	(2) A_1	(3) A_12	(4) A_13
main				
Age	1.801***	1.122***	1.824***	0.805***
	(0.0560)	(0.0210)	(0.0527)	(0.0276)
Single Mother	1.809**	1.975***	1.138	0.751
	(0.380)	(0.312)	(0.216)	(0.235)
Single Mother (step-parent)	4.268***	2.103**	1.533	2.258+
	(1.814)	(0.556)	(0.418)	(1.068)
Single Father	1.962	1.886	1.403	3.280*
	(1.214)	(0.740)	(0.598)	(1.744)
Other	6.663***	3.624***	1.828	1.855
	(3.492)	(1.147)	(0.732)	(1.089)
African american	1.101	1.023	0.952	1.332
	(0.219)	(0.153)	(0.167)	(0.327)
Hispanic	0.669	0.410*	1.460	1.239
	(0.251)	(0.160)	(0.436)	(0.517)
Asian Pacific	2.059	0.519	0.915	1.833
	(1.862)	(0.551)	(0.549)	(1.538)
American Indian	1.136	3.489	1	1
	(1.379)	(2.715)	(.)	(.)
Other	2.486*	1.362	2.660*	0.285
	(1.063)	(0.440)	(1.105)	(0.295)
PCG - Looking for work	1.111	1.556	1.401	2.857**
	(0.421)	(0.438)	(0.550)	(1.136)
PCG - Housewife	2.088*	1.480	1.831+	1.118
	(0.737)	(0.408)	(0.602)	(0.466)
PCG - Student	0.689	0.626	4.026*	0.603
	(0.438)	(0.356)	(2.833)	(0.643)
PCG - Other	5.163+	3.112+	1.260	1
	(4.743)	(1.947)	(0.928)	(.)
Female	0.871	0.804+	1.002	0.976
	(0.150)	(0.106)	(0.145)	(0.206)
Earnings	1.076	1.041	1.051	1.179
	(0.103)	(0.0781)	(0.0902)	(0.143)
Observations	1669	1631	1533	1414
Pseudo R^2	0.594	0.070	0.422	0.088

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Logit regressions (Odd ratio). Attrition is a dummy equals to 1 if the child attrit, whatever the wave. A_1 is a dummy indicating that the child attrit in the second wave, A_12 is a dummy indicating that the child attrit in the third wave, A_13 is a dummy indicating that the child attrit in the second wave but was observed in the third wave.

Source : PSID - CDS, waves 1997, 2002 and 2007

6 Concluding discussion

While a large literature has found a negative effect of parental separation on child development, little attention has been paid to the driving channels of this effect. A burgeoning literature stress the importance of parental times investments. In this paper, I wonder if parental times investments could be a driving channel of the effect of parental separation on child development. Besides, this paper extends the literature on parental times to time with father and with both parents together.

First, this paper examines whether the family structure impacts child and parental time investments. Second, it models time input production functions with a value added and cumulative value added specification considering a possible heterogeneity of the effect of parental times investments according to child's gender and PCG's education.

Estimating the impact of family structure on child time investments, I draw attention on three findings. First, family structure does not have any impact on total child time investments (whoever is there). However, time with at least one parent present decreases. Estimations do not suggest any effect on time with at least one parent involved. Second, the composition of accessible and engaged parental times is highly affected. Time with both parents together and with the non custodial parent (only) decreases in major part of activities. Custodial parent compensates partially for the decrease in time spent with the non custodial parent, and aim to maintain amount of qualitative time. Third, this shows a small complementarity between father and mother time in these families. Since substitution is high when we look at involvement of parents, custodial parent's time constraints may be a better explanation for this partial substitution.

Estimating the effect of time allocation on child cognitive and non-cognitive skills, I draw attention on one main finding and other substantial findings. My main finding is that cognitive and non-cognitive production functions show that all parental times investments do not have the same impact on child development, meaning the time spent with the mother does not have the same impact than time spent with father or both parents. If no clear evidence appear, a Wald test shows that accessible parental times are not equivalent regarding to emotional skills and engaged parental times are not equivalent for cognitive skills. The cumulative value added model confirms this last finding.

The way children allocate their time matters for both cognitive and non-cognitive skills; leisure and educational activities rank at the top. Current time with at least one parent is at stake for emotional skills. The CVA results are consistent with Del Boca et al (2017) [2], previous own child time inputs do not seem to affect child's current test score; however, past education with one parent involved benefit to the child. Considering past parents investments, involvement of parents matters for reading and

(externalising) BPI. Presence of parents matters for all outcomes except math skills.

Estimations results suggest that girls' non-cognitive skills may respond differently than boys to the total amount of time in each activity. Nevertheless, engaged parental times do not have differential effect along with gender, only girls' reading skills seem to respond differently to the presence of parents. Finally, children with more highly educated parents respond more to active leisure. Production functions of reading skills, and externalising skills are different. This is consistent with Del Bono et al (2016) [3] results. This could reflect differences in the type of activities. Parenting style and parents' skills are also very likely to explain these differences.

From these results, it appears that parental time investments could be a driving channel of the effect of parental separation. On one hand, the decrease in the accessible time of parents may explain negative effect on emotion, especially for girls, this could explain why girls may suffer more from parental separation when emotional skills are considered (see Lundberg 2017 [15]). Also, the time channel may be particularly at stake for children whose parents get separated in their early childhood. On the other hand, the change in the composition of parental times may be a driving channel of the effect of parental separation on reading and non cognitive skills, especially for children with more highly educated parents. The results have important policy implications. Single parent families should be targeted, not only with cash transfers but also with "time transfers". We could imagine labour market policies allowing for more flexible schedules, or helps for the housework production activities such as grocer's. Differences among labour policies or social norms may explain differences across countries.

This study is one of the first attempts to estimate heterogeneity of parental times investments, there are desirable extensions that relies on data improvements, especially in collecting information about early childhood both on cognitive and non-cognitive skills and on child and parental time investments. Models of production functions require a lot of data, especially on past inputs: if we want to study the time input production functions for young children, we need data on their skills when they were even younger.

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7 Appendix

A1 Descriptive Statistics: Effect of Family Structure

Table A1 shows that children who do not live with their two parents have lower scores in Math and Reading and higher behaviour problems. Table A2 shows demographic differences between the two groups. Children who do not live with their two parents are less likely to be White, Hispanic or Asian but more likely to be African American or American Indian. Their Primary Care Givers (PCG) is less likely to be a housewife, and more likely to look for work or being a student.

Tables A3 to A7 show the effect of family structure on child allocation of time. Children who do not live with their two parents spend on average less time in personal needs and care and in active leisure, but much more time in education and in passive leisure. They spend less time in education and active leisure with nobody involved in the activity; but more time in passive leisure and (house)work with nobody involved. They spend slightly more time with nobody around, doing (house)work, personal needs and care, and passive leisure.

They spend on average less time with at least one parent, involved or present, in all activities. When we look at the decomposition of parental times, their mother (only) spend more time with them involved in personal needs and care and passive leisure; and she is more present when they are doing personal needs and care, educational activities or leisure. On the other hand, fathers, generally the non custodial

parent, are less involved and less present in all activities. They spend also less time with their two parents together involved in the activity or present.

Table A1 – Summary Statistics by Family Structure

	Not with two parents		
	mu_1	mu_2	b/se
Reading Score	-0.25	0.18	-0.435**
			(0.03)
Math Score	-0.28	0.20	-0.476**
			(0.03)
Total BPI	-0.19	0.14	-0.329**
			(0.03)
Internalising BPI	-0.14	0.10	-0.237**
			(0.03)
Externalising BPI	-0.20	0.15	-0.350**
			(0.03)
Observations	5967		

Table A2 – Summary Statistics by Family Structure

	Not with two parents		
	mu_1	mu_2	b/se
Age	10.74	9.79	0.944**
			(0.13)
Female	0.49	0.49	-0.007
			(0.01)
White	0.29	0.64	-0.350**
			(0.01)
African american	0.61	0.21	0.406**
			(0.01)
Hispanic	0.04	0.10	-0.055**
			(0.01)
Asian Pacific	0.01	0.02	-0.016**
			(0.00)
American Indian	0.01	0.00	0.005**
			(0.00)
Other	0.04	0.03	0.010*
			(0.00)
PCG - Worker	0.70	0.69	0.006
			(0.01)
PCG - Looking for work	0.11	0.03	0.075**
			(0.01)
PCG - Housewife	0.15	0.25	-0.097**
			(0.01)
PCG - Student	0.03	0.02	0.016**
			(0.00)
PCG - Other	0.01	0.01	-0.000
			(0.00)
Earnings	9.66	9.66	-0.006
			(0.03)
Observations	5967		

Table A3 – Summary Statistics by Family Structure

	Not with two parents		
	mu_1	mu_2	b/se
(House)Work	6.42	6.46	-0.038
			(0.23)
Personal needs and care	85.63	87.91	-2.286**
			(0.42)
Education	31.13	29.40	1.733**
			(0.47)
Active Leisure	18.60	21.38	-2.778**
			(0.34)
Passive Leisure	26.10	22.80	3.299**
			(0.34)
(House)Work (alone)	1.23	0.99	0.238**
			(0.06)
Personal needs and care (alone)	1.39	1.38	0.007
			(0.07)
Education (alone)	1.97	2.34	-0.372**
			(0.12)
Active Leisure (alone)	3.53	4.51	-0.977**
			(0.17)
Passive Leisure (alone)	6.48	5.46	1.020**
			(0.21)
(House)Work (alone) (presence)	0.34	0.26	0.076*
			(0.03)
Personal needs and care (alone) (presence)	0.29	0.22	0.069*
			(0.03)
Education (alone) (presence)	0.46	0.43	0.037
			(0.06)
Active Leisure (alone) (presence)	0.68	0.74	-0.068
			(0.08)
Passive Leisure (alone) (presence)	1.69	1.22	0.468**
			(0.11)
Observations	5967		

Table A4 – Summary Statistics by Family Structure

	Not with two parents		
	mu_1	mu_2	b/se
(House)Work (with at least one parent)	2.19	3.51	-1.317**
			(0.12)
Personal needs and care (with at least one parent)	4.27	6.75	-2.483**
			(0.15)
Education (with at least one parent)	0.87	1.17	-0.295**
			(0.07)
Active Leisure (with at least one parent)	2.66	5.11	-2.448**
			(0.17)
Passive Leisure (with at least one parent)	5.77	7.79	-2.016**
			(0.18)
(House)Work (with at least one parent) (presence)	3.01	4.44	-1.422**
			(0.14)
Personal needs and care (with at least one parent) (presence)	5.28	8.28	-3.005**
			(0.16)
Education (with at least one parent) (presence)	1.89	3.05	-1.162**
			(0.12)
Active Leisure (with at least one parent) (presence)	7.08	12.25	-5.174**
			(0.27)
Passive Leisure (with at least one parent) (presence)	11.70	14.73	-3.037**
			(0.27)
Observations	5967		

Table A5 – Summary Statistics by Family Structure

	Not with two parents		
	mu_1	mu_2	b/se
(House)Work (with mother only)	1.86	2.04	-0.186^{+}
			(0.10)
Personal needs and care (with mother only)	3.55	3.11	0.438**
			(0.13)
Education (with mother only)	0.78	0.81	-0.032
			(0.06)
Active Leisure (with mother only)	1.96	1.98	-0.021
			(0.12)
Passive Leisure (with mother only)	4.75	3.51	1.245**
			(0.14)
(House)Work (with mother only) (presence)	2.48	2.23	0.243*
			(0.11)
Personal needs and care (with mother only) (presence)	4.36	3.21	1.153**
			(0.12)
Education (with mother only) (presence)	1.58	1.36	0.225**
			(0.09)
Active Leisure (with mother only) (presence)	5.60	4.78	0.830**
			(0.20)
Passive Leisure (with mother only) (presence)	9.74	5.77	3.965**
			(0.22)
Observations	5967		

Table A6 – Summary Statistics by Family Structure

	Not with two parents		
	mu_1	mu_2	b/se
(House)Work (with father only)	0.20	0.59	-0.392**
			(0.05)
Personal needs and care (with father only)	0.35	0.79	-0.439**
			(0.05)
Education (with father only)	0.07	0.23	-0.158**
			(0.03)
Active Leisure (with father only)	0.53	1.33	-0.804**
			(0.08)
Passive Leisure (with father only)	0.66	1.71	-1.051**
			(0.08)
(House)Work (with father only) (presence)	0.24	0.59	-0.347**
			(0.05)
Personal needs and care (with father only) (presence)	0.37	0.68	-0.304**
			(0.04)
Education (with father only) (presence)	0.12	0.31	-0.196**
			(0.04)
Active Leisure (with father only) (presence)	0.86	1.62	-0.754**
			(0.10)
Passive Leisure (with father only) (presence)	0.93	1.78	-0.847**
			(0.10)
Observations	5967		

Table A7 – Summary Statistics by Family Structure

	Not with two parents		
	mu_1	mu_2	b/se
(House)Work (with parents together)	0.14	0.87	-0.740**
			(0.05)
Personal needs and care (with parents together)	0.37	2.85	-2.482**
			(0.07)
Education (with parents together)	0.03	0.13	-0.105**
			(0.02)
Active Leisure (with parents together)	0.18	1.80	-1.623**
			(0.08)
Passive Leisure (with parents together)	0.36	2.57	-2.210**
			(0.09)
(House)Work (with parents together) (presence)	0.29	1.61	-1.318**
			(0.07)
Personal needs and care (with parents together) (presence)	0.55	4.40	-3.854**
			(0.09)
Education (with parents together) (presence)	0.19	1.38	-1.192**
			(0.07)
Active Leisure (with parents together) (presence)	0.61	5.86	-5.250**
			(0.15)
Passive Leisure (with parents together) (presence)	1.03	7.18	-6.154**
			(0.16)
Observations	5967		

A2 Not *yet* separated as a control group

A2.1 Descriptive statistics

Here we look at the differences between two groups : those whose parents will never separate in the sample (before the age of 19), and those whose parents will separate later, but the separation has not happened yet. It permits to compare children from separated parents but who have not affected by the separation yet, since it has not been occurred yet. It gives an idea of the selection.

Table A8 shows descriptive statistics for children whose parents are going to separate (but are not separated yet) against those whose parents will never separate. The former group has lower cognitive and non-cognitive skills. Their primary care giver is more likely to be a student.

Figure A1 shows differences in allocation of time between the two groups. Children whose parents are going to separate spend on average more time in personal needs and care, less time in educational activities. They spend on average less time with their two parents, and more time with their mother only. They spend more time in personal needs and care with at least one parent. These statistics suggest that fathers are already less involved and less present at home when a separation is about to occur. This could be the reason why they separate or the reflect of couples troubles.

Figures A2 and A3 show the distribution of time spent with father only, and with both parents together involved and present among the two groups. Children whose parents are going to separate are more likely to declare spending time with their father only than those whose parents will never separate; on the other hand, they are less likely to declare spending time with their two children. The separation may therefore not affect time with parents together who already avoid themselves before the separation.

A2.2 Results

Here, we test another method to control for family structure endogeneity. We control for the group whose parents are not separated yet, but are going to separate. The "Not yet broken up" will indicate the selection of separation, while the other coefficients will catch a causal effect. This method is similar to a diff-and-diff.

Table A8 – Descriptive statistics: Children whose parents will never separate / whose parents are going to separate

	Future separation		
	mu_1	mu_2	b/se
Reading Score	-11.542	21.343	-32.884**
			(6.486)
Math Score	-21.998	24.654	-46.652**
			(5.771)
Total BPI	-7.476	15.880	-23.356**
			(5.207)
Internalising BPI	-1.927	10.872	-12.799*
			(5.184)
Externalising BPI	-10.691	17.403	-28.094**
			(5.293)
PCG - Worker	0.683	0.694	-0.011
			(0.023)
PCG - Looking for work	0.043	0.029	0.015^{+}
			(0.009)
PCG - Housewife	0.224	0.252	-0.028
			(0.021)
PCG - Student	0.050	0.013	0.036**
			(0.007)
PCG - Other	0.000	0.012	-0.012*
			(0.005)
Earnings	9.660	9.664	-0.003
			(0.067)
Observations	3618		

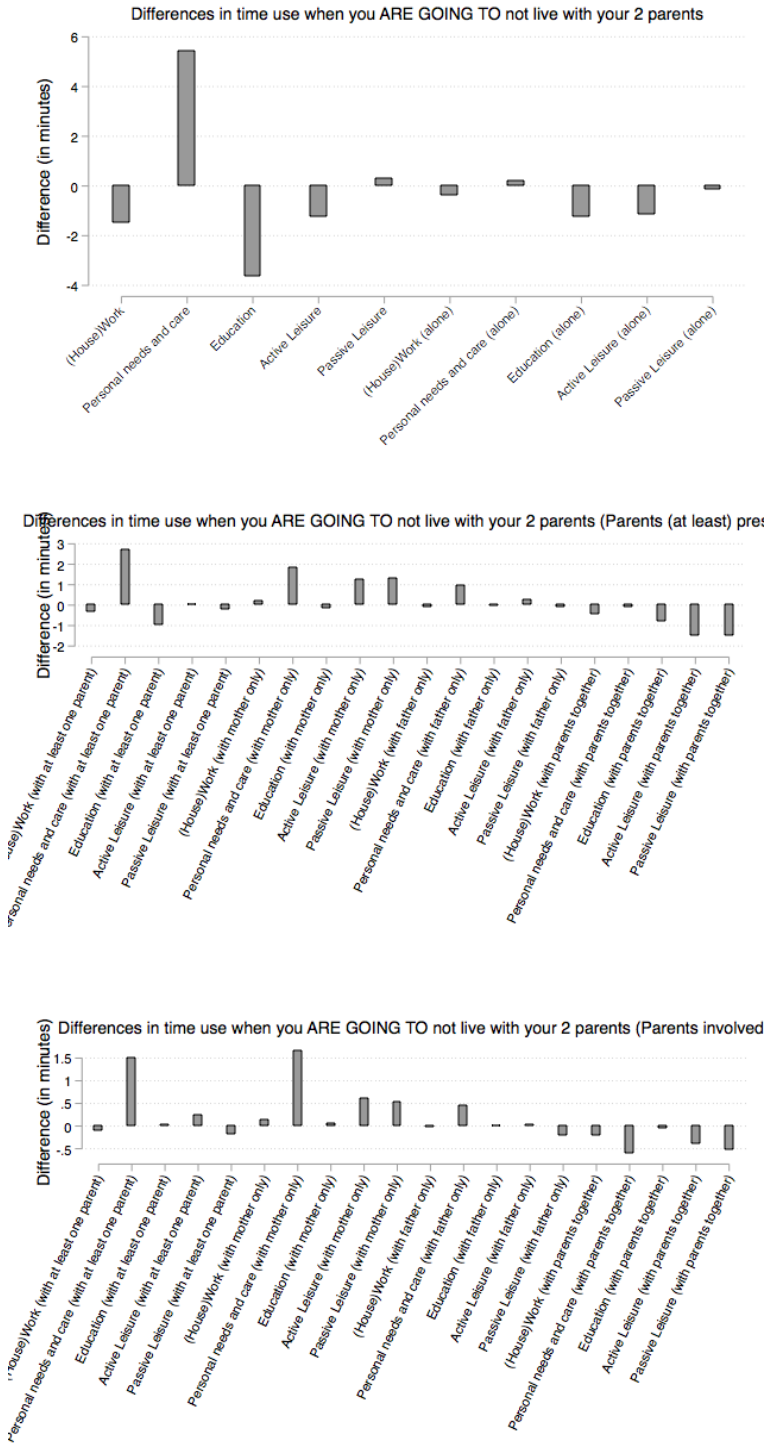

Fig. A1. T-tests on Time Investments

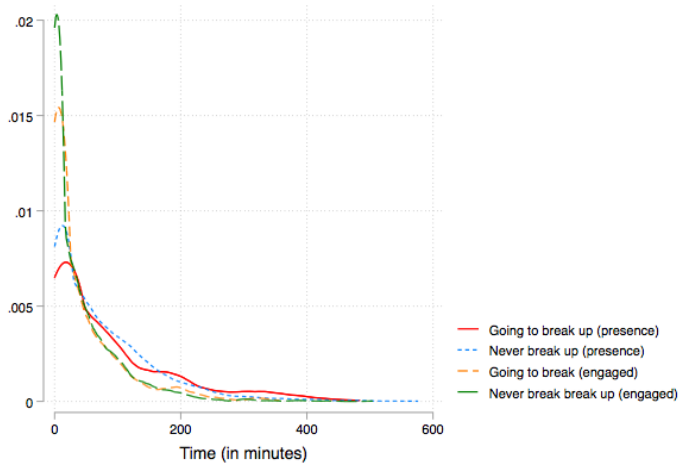

Fig. A2. Distribution of time with father (involved or present) among fathers who will separate / never separate

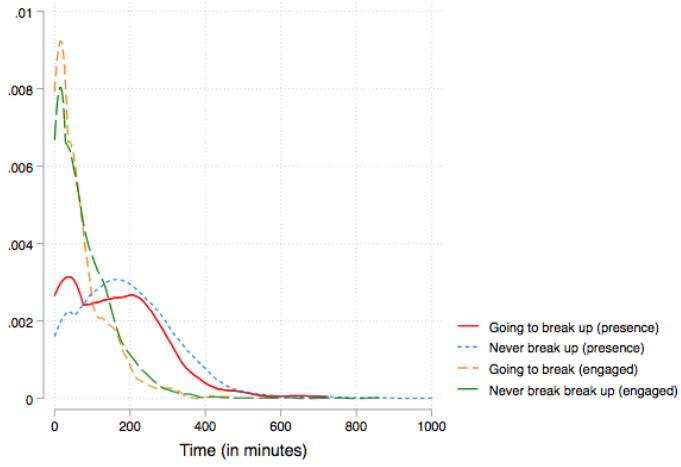

Fig. A3. Distribution of time with time with parents together (involved or present) among parents who will separate / never separate

Table A9 – Effect of Family Structure on Total Allocation of Time

Panel A : Overall Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.04	−0.06	−0.01	−0.05	0.12*
	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
Single Mother (step-parent)	−0.03	−0.07	0.15**	−0.14*	0.00
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
Single Father	0.13	−0.15+	−0.01	0.08	−0.02
	(0.12)	(0.09)	(0.10)	(0.11)	(0.09)
Other	−0.09	0.11	−0.15	0.04	0.06
	(0.10)	(0.10)	(0.10)	(0.09)	(0.09)
Not yet broken up	−0.05	−0.11+	0.11	−0.07	0.08
	(0.06)	(0.07)	(0.07)	(0.07)	(0.06)
Observations	3834	3834	3834	3834	3834

Panel B : Time with at least One Parent : Accessible Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.12**	−0.31***	−0.20***	−0.24***	−0.19***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Single Mother (step-parent)	−0.24***	−0.44***	−0.22***	−0.53***	−0.53***
	(0.06)	(0.08)	(0.06)	(0.06)	(0.06)
Single Father	−0.17	−0.48***	−0.38***	−0.10	−0.36***
	(0.11)	(0.08)	(0.07)	(0.11)	(0.09)
Other	−0.47***	−0.76***	−0.50***	−0.59***	−0.85***
	(0.07)	(0.10)	(0.06)	(0.07)	(0.09)
Not yet broken up	−0.02	−0.11+	−0.09	−0.14*	−0.00
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
Observations	3834	3834	3834	3834	3834

Panel C : Time with at least One Parent : Engaged Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.15**	−0.23***	−0.06	−0.25***	−0.18***
	(0.05)	(0.04)	(0.04)	(0.05)	(0.05)
Single Mother (step-parent)	−0.25***	−0.34***	−0.04	−0.36***	−0.35***
	(0.05)	(0.06)	(0.06)	(0.07)	(0.06)
Single Father	−0.17	−0.35***	−0.14*	−0.05	−0.23*
	(0.12)	(0.08)	(0.07)	(0.10)	(0.11)
Other	−0.45***	−0.58***	−0.27***	−0.41***	−0.72***
	(0.06)	(0.09)	(0.06)	(0.08)	(0.07)
Not yet broken up	−0.03	−0.08	−0.07	−0.17**	−0.04
	(0.07)	(0.06)	(0.05)	(0.06)	(0.06)
Observations	3834	3834	3834	3834	3834

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Random Effect Results. Time variables are standardised for a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included, along with death of a parent and the absence of father at birth. I add another control group who has not *yet* break up.

Source : PSID - CDS, waves 1997, 2002 and 2007

A3 Time Input Production Functions: Fixed Effect Results

Table A10 – Time Input Production Functions : Total Time (whoever was there)

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.04*	0.02	0.05*	0.04*	0.04+
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education	0.06+	0.05*	0.05*	0.06*	0.02
	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)
Active Leisure	0.05	0.03	0.09***	0.09***	0.06*
	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)
Passive Leisure	0.01	0.02	0.02	0.02	0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	2954	3278	3399	3425	3425
N_clust	1842.00	1914.00	1962.00	1973.00	1969.00

Individual Fixed Effects Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table A11 – Time Input Production Functions : Effect of the presence of at least one parent

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.03	0.01	0.06*	0.04	0.07*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.06	0.04+	0.06*	0.06*	0.03
	(0.04)	(0.02)	(0.03)	(0.03)	(0.03)
Active Leisure	0.04	0.03	0.09***	0.09***	0.07*
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.02	0.02	−0.03	−0.03	−0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.02	0.00	−0.02	0.00	−0.05+
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	0.01	0.01	−0.01	0.01	−0.02
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	0.02	0.00	0.00	0.00	−0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Passive Leisure (with at least one parent)	−0.01	0.00	0.10***	0.08***	0.11***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	2954	3278	3399	3425	3425
N_clust	1842.00	1914.00	1962.00	1973.00	1969.00

Table A12 – Time Input Production Functions : Effect of the involvement of at least one parent

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.02	0.02	0.05+	0.03	0.05+
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Education	0.06+	0.05*	0.05*	0.06*	0.02
	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)
Active Leisure	0.05	0.03	0.09***	0.09***	0.06*
	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)
Passive Leisure	0.02	0.01	−0.00	−0.00	−0.01
	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	−0.01	0.00	0.01	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with at least one parent)	0.01	0.00	−0.02	−0.01	−0.02
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	−0.00	0.01	−0.01	−0.02	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with at least one parent)	−0.02	0.02	0.06**	0.05*	0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	2954	3278	3399	3425	3425
N_clust	1842.00	1914.00	1962.00	1973.00	1969.00

Individual Fixed Effects Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table A13 – Time Input Production Functions : Does whom is present matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.03	0.01	0.06*	0.04	0.08*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.06	0.04+	0.06*	0.06*	0.03
	(0.04)	(0.02)	(0.03)	(0.03)	(0.03)
Active Leisure	0.03	0.03	0.09***	0.09***	0.07*
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.02	0.02	−0.03	−0.03	−0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.00	−0.00	−0.02	−0.01	−0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	0.02	0.02	−0.01	0.01	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Active Leisure (with at least one parent)	0.00	−0.01	0.03	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	0.01	0.01	0.10***	0.07*	0.13***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with parents together)	0.01	0.03	−0.01	0.01	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with parents together)	−0.01	−0.01	−0.01	−0.00	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with parents together)	0.04	0.01	−0.02	−0.02	−0.01
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
Passive Leisure (with parents together)	−0.02	−0.02	−0.02	0.00	−0.05+
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with father only)	0.02	−0.01	0.01	0.03+	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with father only)	0.00	−0.01	0.02	0.01	0.02
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Active Leisure (with father only)	0.00	0.01	−0.03	−0.02	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with father only)	−0.02	0.00	0.02	0.02	0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	2954	3278	3399	3425	3425
N_clust	1842.00	1914.00	1962.00	1973.00	1969.00

Individual Fixed Effects Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table A14 – Time Input Production Functions : Does whom is involved matter ?

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.02	0.02	0.05+	0.03	0.05+
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.06+	0.05*	0.05*	0.06*	0.02
	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)
Active Leisure	0.05+	0.03	0.09***	0.09***	0.06*
	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)
Passive Leisure	0.02	0.01	−0.00	−0.00	−0.00
	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.03	−0.02	0.01	0.00	−0.00
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with at least one parent)	0.01	0.00	−0.04+	−0.01	−0.04+
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	−0.01	0.01	−0.01	−0.02	−0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.01	0.04	0.07*	0.05+	0.09**
	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
(House)Work (with parents together)	−0.01	0.04*	−0.02	0.00	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with parents together)	−0.05**	−0.00	−0.00	−0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Active Leisure (with parents together)	0.03	0.00	0.00	−0.00	0.01
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with parents together)	−0.04	−0.02	−0.02	−0.00	−0.04
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
(House)Work (with father only)	0.01	0.00	0.00	0.02	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with father only)	0.02	−0.00	0.04*	0.03	0.05*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with father only)	−0.01	0.01	0.01	0.01	0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with father only)	0.01	−0.01	−0.00	0.01	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	2954	3278	3399	3425	3425
N_clust	1842.00	1914.00	1962.00	1973.00	1969.00

Individual Fixed Effects Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

A4 Results on the balanced panel

Table A15 – Effect of Family Structure on Time Allocation (Balanced Panel)

Panel A : Total Time (whoever was there)

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.04	0.08	−0.11	0.15	−0.09
	(0.14)	(0.14)	(0.12)	(0.11)	(0.13)
Single Mother (step-parent)	−0.14	−0.06	0.28+	0.07	−0.27
	(0.21)	(0.19)	(0.16)	(0.21)	(0.17)
Single Father	−0.04	0.24	0.04	0.05	−0.28
	(0.24)	(0.19)	(0.24)	(0.26)	(0.22)
Other	−0.38	0.11	−0.28	0.13	0.22
	(0.29)	(0.23)	(0.26)	(0.33)	(0.27)
Observations	1850	1850	1850	1850	1850

Panel B : Time with at least One Parent : Accessible Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.32*	−0.14	−0.19	0.02	−0.26*
	(0.14)	(0.09)	(0.12)	(0.11)	(0.13)
Single Mother (step-parent)	−0.34	−0.27	−0.22	−0.24	−0.54**
	(0.22)	(0.18)	(0.18)	(0.17)	(0.18)
Single Father	−0.13	−0.37*	0.04	0.13	−0.14
	(0.28)	(0.17)	(0.23)	(0.29)	(0.21)
Other	−0.40+	−0.20	−0.48**	−0.20	−0.18
	(0.21)	(0.26)	(0.17)	(0.22)	(0.20)
Observations	1850	1850	1850	1850	1850

Panel C : Time with at least One Parent : Engaged Time

	(House)Work	Personal needs and care	Education	Active Leisure	Passive Leisure
Single Mother	−0.29*	−0.02	0.00	−0.06	−0.18+
	(0.14)	(0.10)	(0.09)	(0.10)	(0.10)
Single Mother (step-parent)	−0.28	−0.03	0.00	−0.01	−0.22
	(0.19)	(0.17)	(0.17)	(0.21)	(0.16)
Single Father	−0.13	−0.38+	−0.06	0.11	−0.12
	(0.31)	(0.21)	(0.10)	(0.25)	(0.23)
Other	−0.49*	−0.04	−0.35+	−0.01	−0.31*
	(0.25)	(0.20)	(0.18)	(0.33)	(0.12)
Observations	1850	1850	1850	1850	1850

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Individual Fixed Effect Model. Time variables are standardised for a mean of 0 and a standard deviation of 1. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included, along with death of a parent and the absence of father at birth.

Source : PSID - CDS, waves 1997, 2002 and 2007

Table A16 – Time Input Production Functions : Total Time (whoever was there)

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.07	0.02	0.02	0.01	0.03
	(0.05)	(0.03)	(0.03)	(0.03)	(0.04)
Education	0.12	0.07*	0.06+	0.03	0.08*
	(0.09)	(0.04)	(0.04)	(0.04)	(0.04)
Active Leisure	0.14+	0.09*	0.07*	0.05+	0.07+
	(0.08)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.05	0.05	0.03	0.01	0.06
	(0.06)	(0.03)	(0.04)	(0.04)	(0.04)
Observations	788	1019	1053	1062	1063
N_clust	674.00	699.00	715.00	719.00	718.00

Individual Fixed Effects Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table A17 – Time Input Production Functions : Effect of the presence of at least one parent

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.06	0.03	0.02	−0.02	0.05
	(0.06)	(0.04)	(0.05)	(0.05)	(0.05)
Education	0.11	0.07+	0.07*	0.03	0.10*
	(0.10)	(0.04)	(0.04)	(0.04)	(0.04)
Active Leisure	0.14+	0.10**	0.08*	0.07*	0.06
	(0.08)	(0.04)	(0.04)	(0.04)	(0.04)
Passive Leisure	0.06	0.07+	−0.02	−0.04	0.02
	(0.08)	(0.04)	(0.04)	(0.04)	(0.04)
(House)Work (with at least one parent)	0.03	−0.00	0.00	0.03	−0.03
	(0.03)	(0.04)	(0.05)	(0.04)	(0.05)
Education (with at least one parent)	0.04	0.03	−0.05	−0.02	−0.07*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Active Leisure (with at least one parent)	−0.00	−0.02	−0.03	−0.04	−0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Passive Leisure (with at least one parent)	−0.02	−0.04	0.07+	0.07*	0.05
	(0.05)	(0.03)	(0.04)	(0.04)	(0.04)
Observations	788	1019	1053	1062	1063
N_clust	674.00	699.00	715.00	719.00	718.00

Table A18 – Time Input Production Functions : Effect of the involvement of at least one parent

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.04	0.04	0.00	−0.03	0.03
	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)
Education	0.12	0.07+	0.06	0.03	0.08*
	(0.10)	(0.04)	(0.04)	(0.04)	(0.04)
Active Leisure	0.13+	0.09*	0.07*	0.06+	0.06+
	(0.07)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	0.06	0.04	0.01	−0.01	0.04
	(0.07)	(0.04)	(0.04)	(0.04)	(0.04)
(House)Work (with at least one parent)	0.05*	−0.02	0.02	0.05	−0.01
	(0.02)	(0.03)	(0.04)	(0.04)	(0.04)
Education (with at least one parent)	0.01	−0.02	−0.03	−0.02	−0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Active Leisure (with at least one parent)	0.03	−0.02	−0.04	−0.04	−0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.04	−0.01	0.04	0.03	0.03
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Observations	788	1019	1053	1062	1063
N_clust	674.00	699.00	715.00	719.00	718.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

A5 Results excluding the outliers

Table A19 – Time Input Production Functions : Total Time (whoever was there)

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.02	0.02	0.03	0.04	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education	0.05*	0.07**	0.06*	0.06*	0.05+
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Active Leisure	0.02	0.06*	0.08**	0.07**	0.06*
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Passive Leisure	−0.01	0.04+	0.01	0.00	0.03
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Observations	1190	1457	1545	1565	1569
N_clust	1101.00	1204.00	1275.00	1291.00	1293.00

Individual Fixed Effects Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007

Table A20 – Time Input Production Functions : Effect of the presence of at least one parent

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.01	0.02	0.04	0.03	0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.05*	0.06**	0.07**	0.06*	0.06*
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Active Leisure	0.01	0.05+	0.09**	0.09**	0.06*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	−0.00	0.05+	−0.02	−0.03	−0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.02	−0.00	−0.01	0.01	−0.02
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Education (with at least one parent)	0.01	0.01	−0.02	0.01	−0.05*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	0.02	0.01	−0.02	−0.03	−0.01
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Passive Leisure (with at least one parent)	−0.00	−0.01	0.05*	0.05*	0.05*
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Observations	1190	1457	1545	1565	1569
N_clust	1101.00	1204.00	1275.00	1291.00	1293.00

Table A21 – Time Input Production Functions : Effect of the involvement of at least one parent

	(1) Reading Score	(2) Math Score	(3) Total BPI	(4) Externalising BPI	(5) Internalising BPI
(House)Work	0.01	0.02	0.03	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Education	0.05*	0.07**	0.06*	0.06*	0.05+
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Active Leisure	0.02	0.05*	0.08**	0.08**	0.06*
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Passive Leisure	−0.01	0.04+	0.00	−0.01	0.01
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
(House)Work (with at least one parent)	0.02	−0.01	0.02	0.04	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education (with at least one parent)	0.00	−0.02	−0.01	−0.01	−0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Active Leisure (with at least one parent)	0.01	0.01	−0.02	−0.02	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Passive Leisure (with at least one parent)	0.01	0.00	0.03	0.02	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	1190	1457	1545	1565	1569
N_clust	1101.00	1204.00	1275.00	1291.00	1293.00

Value Added Model. Cognitive test scores are standardised on the national average by age groups, and for a mean of 0 and a standard deviation of 1. Broad reading and math test scores are taken from age of 6 and from age of 3, respectively. BPI is provided by the Primary Care Giver from the age of 3. Time variables are also standardised for a mean of 0 and a standard deviation of 1. For the sake of simplicity, BPI scales have been reversed : an increase in BPI means a lower Behaviour Problem Index which is good for the child's development. Controls for Sex, Ethnycity, Age, Number of siblings, PCG's education, employment status and earnings are included. Family Structure is also controlled for, including dummies for death of a parent and the absence of father at birth.

Clustered standard errors in parentheses. + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: PSID - CDS, waves 1997, 2002 and 2007