The intergenerational effect of parental enthusiasm for reading

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Abstract

Purpose – This paper aims to focus on how reading for pleasure is transmitted within the family. Using data taken from the Programme for International Student Assessment test of 2009, which dealt in depth with the reading proficiency of students, the authors show that children of parents who read for pleasure are better readers. Within the extensive research and published results on reading performance, the authors focused on the transmission of parents' reading attitudes to their children.

Design/methodology/approach – In this study, the authors have opted for an approach of "difference in differences", applied to a population that represents all 15-year-olds from five countries (Germany, Denmark, Hungary, Italy and Portugal). To support this study, the authors chose as a response variable the difference between reading performance and maths performance of each student, taking into account five plausible values for each student. The authors have several explanatory variables, among them what we call the "treatment", which is the parents' enthusiasm for reading.

Findings – The calculated estimations clearly indicate that there is a positive effect for four out of the five countries analysed, ranging from 4 points for Italy to 6.5 points for Germany and Portugal. As for the significance of the effect, with the exception of Hungary, the result is reliable and robust. It should also be noted that the variable that indicates the existence of a reading habit by children (daily reading for pleasure) is seen as a factor that positively affects the difference between competence in reading and mathematics in four out of the five countries analysed.

Originality value – The results show positive effects on children whose parents read for pleasure, and this fact should be used to further encourage parents to promote their own reading time for pleasure. In view of the already quantified trend in international reports that adults are reading less, it seems crucial to involve

educational authorities in reversing this phenomenon, knowing the impact that adult reading habits have on the reading competence of young people.

1. Introduction

Following the 1966 Coleman's report, there is an ongoing debate on the education production function, and consequently, whether improving schools' financial resources will improve students' achievement. The results have failed to provide robust results, from the statistical point of view, of the impact of school resources on educational outcomes. To summarise the situation on two paradigmatic papers, see Krueger (1999) on the team of those who found positive effects, versus Hanushek (1986) who found negligible or even negative effects. The work now presented is another step on this search for a better specification of the education production function but, instead of searching in the field of the school inputs, we look within the out-of-school factors, specifically the family inputs that influence reading outcomes.

Those family inputs that affect the reading production function form what is known in the literature as the home literacy environment (HLE), clustered on active HLE (i.e. parents teaching to learn their children) and passive HLE (i.e. provision of reading resources, or the very topic analysed in this paper: parents attitudes toward reading). This approach is a specific aspect of the intergenerational transmission (Todd and Wolpin, 2007) of non-cognitive skills (Cunha *et al.*, 2010) . As noted by Coulon *et al.* (2011), there is a certain intergenerational transmission from parents to children; the evidence shows that parents with better numeracy and reading skills have children who show better results in both cognitive and non-cognitive skills.

While other studies have already linked parental attitudes with reading performance [1], our study is unique for four reasons. First of all, most studies on reading area are based on local experiment. See the one in the locality of Haringey, a depressed area outside London (Tizard *et al.*, 1982), that showed that any small parental collaboration has a positive impact on a child's reading ability. Or the study by Flouri and Buchanan (2004) that shown that the involvement of parents in the reading of their children has more influence on young people than other family variables such as social class, family size or educational level of parents, or Chen (2008), in Taiwan, who shows that there are family factors that contribute to a love of reading, and that, although school-related factors are not shown to be relevant, a teacher's own enthusiasm can have positive consequences. Although these findings were interesting, it is difficult to make any inference even at country level. Our study, based on the data provided by Programme for International Student Assessment (PISA) allows for such implications.

Using data from the 2009 edition of the PISA, we show that not only do parents who enjoy reading have children who read better, but that children read better precisely because their parents are enthusiastic readers. The need of the parents' questionnaire on reading habits conditioned our data set: although there are more recent PISA rounds, only in 2009, the reading was assessed in detail, including an optional parent context questionnaire. Unfortunately, only a few countries completed this additional source of information on family reading habits: Germany, Denmark, Hungary, Italy and Portugal within Europe, the countries we have analysed.

The second characteristic that makes our study unique is the econometric strategy used to find causality. Most of the results derived from international surveys are based on correlation between several variables and performance in reading and other competences. For example, the work of Akbasli *et al.* (2016) analyses the effects of reading comprehension on competencies in science and mathematics. From the correlation of data from several

countries included in the PISA test, they find that students who achieve good results in reading comprehension also do so in mathematics and science.

Instead of those descriptive studies (see some of them in Table A1 in the Appendix), our work is related with those that analyse the effectiveness of the parents' involvement in their children's reading activity. We are not just measuring correlations that confirm that parents' attitudes towards reading and parental expectations contribute to the development of children positive attitudes towards literacy (Baker and Scher, 2002 or Yeo *et al.*, 2014). We have measured causality, the effect that parents' role models play on child's preference formation through imitation behaviours, maybe the only process once the children become adolescents.

The age of the students constitutes the third relevant aspect of our paper. It is well known that the relationships between parent and children change with the age. There is an evolution that surely has an effect on the reading and the validity of the models. For example, the work of Hemmerechts *et al.* (2017) analyses the relationship between activities related to reading and reading skills of children, especially taking into account the socioeconomic status of the family. Their study demonstrated the relevance of parents' intervention in their children's reading, when they are still in early childhood education but does this result remain years later? Or the study by Chiu *et al.* (2015) in Taiwan, analysing the influences of the cultural capital of the families on the motivation to read: they found a significant indirect effect on the reading behaviours of primary school students. Consider also the results of a study on six-year-old children by Wiescholek *et al.* (2017) that suggested that both active and passive HLE have an independent significant impact on children reading attitudes.

In contrast to these, our study uses a population that represents all 15-year-old students from various countries, and our results are applicable to those educational systems. Adolescence is not an age for an active influence on the student by the parents. But unexpectedly, it seems that it is the time for a passive influence of the reading enthusiasm observed at home.

The last aspect of this paper that made it different from others is the non-cognitive approach we have adopted in both sides of the equation. Obviously, the enthusiasm of the parents on reading is an attitude, a non-cognitive skill, not easily measurable. Most of the occasions, the time the parents say that they are reading is used as proxy. In our opinion, it is a rough proxy, not only because is self-defied but also because the time someone uses for reading is more correlated with how busy he/she is and his/her spare time. To face this problem, we decided to create our own indicator that will be discussed in due time later.

What we want to point out now is the other not-so-evident non-cognitive variable, our dependent variable. Indirectly, the diff and diff model use produces the measure of an interesting reading competency. Traditional papers only uses the plain plausible values provided by the Organisation for Economic Co-operation and Development (OECD), not considering that there are several skills, ranging from understanding explicitly stated information in a literary text or document to understanding poetry.

In our paper, having considered the difference in performance between a reading and math as our dependent variable, we are dealing with a proxy of the reading for pleasure or gratuitous reading: the part of your reading competence that is "superfluous", that the student has developed "besides" the basic skill she needs to read, for example, the problem presented on a maths exam. So, our paper is also related to those who measure attitude that is assumed to be vitally important because they are likely to influence students' reading behaviour and facilitate the development of reading competencies (Mol and Bus, 2011).

This paper is organised as follows: Section 2 presents what is currently known about the influence of reading on education and about the relationship between parents' behaviour and their children's reading, by showing several social experiments that previously looked

for a causal relationship analogous to the one we are interested in; Section 3 explains the methodology: though the PISA 2009 database is comprehensive, two variables in our study were generated from primary information, and analysed using "Differences in Differences" model; Section 4 shows the results of the study; finally Section 5 contents some conclusions and recommendations.

2. Literature review

Reading is an essential tool for the intellectual development of a person. It is the most common way into the culture of a country. Moreover, cognitive skills are a positively related with salaries, employment prospects and long-term economic growth (Hanushek and Woessmann, 2008). Specifically, Currie and Thomas (2001) found that scores on a reading test taken at early ages are positively correlated with their later earnings. But, knowing how to read is not enough: the reader needs to develop an interest in the written word and practise reading skills regularly. There are several factors that make someone who can read a good reader. One of them is the example set by parents in the home.

Previous paper on the effect of HLE in reading have focus on the parents acting as reading teachers (references) or the effect of the provision of reading resources. For example, in PISA 2009, it was determined that the average reading proficiency score of students from households that had more than 200 books was 25% higher than the average reading proficiency of students from homes where they had almost no books (OECD, 2010).

Our paper is related with those studies that analyse the effect of the parental collaboration. Analysing some of the published findings, it is clear that the involvement of parents in educational performance takes many forms. There are two very comprehensive reviews by Klemencic *et al.* (2014) and by Castro *et al.* (2015), who mention aspects of parental involvement ranging from support for certain programmes within the centre, participation in extracurricular activities or attending meetings with the board of directors. Specifically on the effect of family literacy intervention on children reading acquisition is the meta-analytic review (including combined results for 16 intervention studies) is the work of Sénéchal and Young (2008) that review the scientific literature on parent involvement in the acquisition of reading from Grade 3 to kindergarten.

The parental collaboration we present as treatment is not to provide them with reading materials such as books neither helping to teach children how to read. Those interventions, comparing groups of similar characteristics that only differ in some of the treatment methods, are ideal for proving causality. Some of these interventions are "The Literacy Hour" (Machin and McNally, 2008); Ritchie *et al.* (2015), based on data from the TEDS [2] study; Sullivan and Brown (2015), based on the data of BCS70 [3] or Cardoso *et al.* (2008) who analyse whether parents' preferences regarding the use of their time influence how adolescents use their time.

The parental collaboration we present as treatment is to help by modelling reading themselves. The modelling of reading by parents does not expressly teach children how to read, but rather serves to communicate a preference. When modelling reading, parents are, in effect, modelling enjoyment, enthusiasm or interest in reading. Clark and Rumbold (2006) stress the importance of parents modelling reading to encourage young people to read for pleasures. More specifically, parents who believe that reading is a source of entertainment have children with more positive views about reading than parents who only emphasise the skills aspect of reading (Sonnenschein and Munsterman, 2002).

We believe that the enthusiasm develops what we call reading for pleasure, which in this paper is used interchangeably with reading gratuitously also frequently referred to by a plethora of names like independent reading, voluntary reading, leisure reading, recreational reading. See the monograph "Reading for pleasure: A research overview" by Clark and Rumbold for wider information. Just as a token of its relevance, research

from the OECD showed that reading enjoyment is more important for children's educational success than their family's socio-economic status (OECD, 2002). Reading for pleasure could, therefore, be one important way to combat social exclusion and raise educational standards, and, as we will prove, could be promoted with a little effort of the parents.

3. Methodology
As we have said before, the data of this study come from the PISA. Every three years, this programme, evaluates the competences of 15-year-olds in three main subjects (reading, mathematics and science). In each test, one of the three main subjects is evaluated in more detail. The reading competence was analysed in 2009 for the second time. In addition, the OECD offers optional questionnaire. In 2009, one of these optional questionnaires was the Parent Questionnaire that gave a complementary view of the reading environment a 15-year-old student has at home. Our data comes from this study.

In this section, we will present in detail the data and the econometric technique chosen, a variation of the difference in differences (DiD) model to determine casual relationships and not just correlations between treatment and results.

3.1 Tools used for analysis
There are several econometric strategies to try to isolate the effects of a treatment that, in this case, would be the parents' enthusiasm for reading. In this study, we have chosen the technique of "DiD" by competences, following a route already explored by Cordero and Pedraja (2019) to measure the effect on students' financial knowledge from PISA data [4].

The "DiD" method is primarily designed for panel data, when one group is exposed to one treatment and another is not. To give a simple example, in the case of a reinforcement programme for students with learning difficulties, the average performance of students without such difficulties and that of students with difficulties is calculated before the programme is started. Once the programme has been completed, this difference is recalculated. The variation in the difference is the impact of the policy. However, our situation is not the same: we do not have two moments in time to compare, and our 2009 PISA data is not panel data. So, in line with the original idea of Jürges *et al.* (2005), we apply a variation of the "DiD" using the results of students in two competences, reading comprehension and mathematics, to identify the effect of parents' enthusiasm for reading. More specifically, the following models can be used to explain the results in mathematics and reading:

$$Math_i = \mu_i + \beta X_i + \delta_M T_i + \epsilon_i^M \tag{1}$$

$$Read_i = \mu_i + \gamma X_i + \delta_R T_i + \epsilon_i^R \tag{2}$$

where $Math_i$ is the result of the student's maths proficiency i in PISA 2009, $Read_i$ is the student's proficiency in reading comprehension, μ_i are the individual characteristics of the subject i, X_i is a matrix that contains the control variables of the model (immigrant, repetition, female, [...]), T_i is the treatment variable, (parents' enthusiasm for reading) and finally, ϵ_i^M and ϵ_i^R are the random disturbances of each model, which we will assume meet the usual assumptions in these cases.

From these models, if, instead of studying the performance separately in each competence, we analyse the variable difference between competences (which is precisely what we have done to explain $diff_{i,j}^{R-M}$), the resulting model is as follows:

$$Read_i - Math_i = diff_i^{R-M} = (\gamma - \beta)X_i + (\delta_R - \delta_M)\ T_i + \epsilon_i^{R-M} \tag{3}$$

Where $(\delta_R - \delta_M) = \delta_{DIF}$ represents the effect of the treatment on the difference in performance between reading and mathematics. With this transformation, the specific characteristics of the subjects, the non-observable stable part μ, have disappeared from the model. On a simplistic level, we could consider that each student is a control for herself (Cordero and Pedraja, 2019).

With this transformation, if the δ_{DIF} coefficient is significantly different from zero, and positive, once the effects of the control variables have been discounted, we can affirm that the treatment "parents' enthusiasm for reading" has a positive effect on reading, which surpasses the effect it has on mathematics. That is to say, the parents' enthusiasm for reading causes an improvement in the reading competence of children.

For this strategy of identification of the effect of the treatment to be credible, it has to meet two conditions that, in our case, we can assume are given. The first condition is that the parents' enthusiasm for reading influences the children's reading skills more than the maths skills. In this case, we supported this assumption on the results of the correlation for each country [5]. Finally, we considered no spillover effects and identical relative preferences between reading and math. In this case, we cannot demonstrate due the lack of information about it in the database and constitutes a limitation of the work.

Once the estimation strategy is decided, i.e. the "DiD" model, the last step of the process is to implement the model and estimate the coefficients to find out if the parents' enthusiasm for reading influences the reading habits of their children.

As already mentioned, PISA data has a complex structure that requires specific calculations to obtain reliable results. More detailed information can be found in the PISA 2009 Technical Report (OECD, 2012). In this study, we opt for REPEST, the STATA routine developed by Avvisati and Keslair (2014) to analyse the data. REPEST carries out the estimations using the BRR weights proposed by the OECD and is suitable for use with plausible values, such that the average value of the estimations is obtained and the imputation error is incorporated into the variance of the estimated parameter.

Calculating the difference for each pair of plausible values of the two subjects allows us to maintain the structure of the data and, therefore, makes it possible to use the BRR replicates and the rest of the statistical advantages in the estimation offered by REPEST, when there are plausible values. The results obtained with this method are technically robust and meet the criteria of the usual OECD studies.

3.2 Data and variables
As already mentioned, the data for this study come from the PISA 2009 database. As our study analyses the effect of parents' reading habits on their children's reading, our sample is restricted to those countries for which context questionnaires were completed by the parents. In the European environment, these countries are Germany, Denmark, Hungary, Italy and Portugal, which together provide a sample of 52,711 students, representative of 23 million young people aged 15.

From the enormous information generated by PISA 2009, we choose a small group of variables, which we group into two types: response variables and explanatory variables.

The response variable in this study is the difference between the reading comprehension performance and the maths performance of each student [6].

3.2.1 The response variable. PISA 2009 indicates both the level of reading competence and the level of maths competence of each student. From this information, it seems simple to generate the response variable "difference between reading and mathematics". However, PISA's way of presenting the results (see PISA 2013 Technical Report for a complete explanation of the IRT approach) makes it complicated to obtain this response variable directly. Indeed, for PISA, student reading performance is not a single value, but five, and student maths performance is not a single value, but five. Therefore, there is not one difference in performance for each student, but five differences.

Thus, with our response variable in mind, the difference between performance in reading comprehension and performance in mathematics is, in fact, the difference between five plausible values of reading and five plausible values of mathematics. It is better to maintain this structure: it would be a mistake to lose this information by simplifying the variable with an average of the five values, as the model would be impoverished. Therefore, to maintain the structure of plausible values, we define our variable as:

$$diff_{i,j}^{R-M} = pv\_read_{i,j} - pv\_math_{i,j}; \ j = 1, 2, \ldots, 5 \qquad (4)$$

$pv\_read_{i,j}$ is the plausible value j for reading performance of student i, $pv\_math_{i,j}$ is the plausible value j for mathematics performance of the same student i and $diff_{i,j}^{R-M}$ is each one of the differences between the performance in reading and mathematics. In this way, we keep in our response variable the essence of PISA performance: plausible values.

Having a response variable in the form of five plausible values has a number of methodological advantages. Specifically, it allows the OECD instructions to be followed so that the estimations of the sample errors of the parameters include the estimation errors, the sampling errors and the measurement errors that the complex structure of the PISA data entails.

After taking into account these technical aspects, the results in 2009 for the reading and maths skills of the countries studied are significantly different from zero. In all countries, the difference between reading competence and maths competence is relevant. But, it is not an unexpected result: the fact that boys show a better average performance in mathematics than in reading is typical (and therefore, the negative difference); the fact that girls read better than boys is also common place (and therefore, the positive difference).

Nevertheless, the expected result for the response variable "difference between reading performance and maths performance" can help us determine the extent to which the parents' enthusiasm for reading develops better readers in their children. We do this with the help of a "DiD" model and the following explanatory variables.

The explanatory variables are classified into control variables and the treatment variable. We analyse whether the parents' enthusiasm for reading has an impact on the reading of the children. That is, if those children who receive the "treatment" of parents who are readers read better than their peers who do not receive that "treatment", discounting the other characteristics that could have an influence.

3.2.2 The treatment variable. The treatment variable in our study, "parents' enthusiasm for reading", cannot be measured directly. Like other variables, such as quality or elegance, these are latent variables which one attempts to measure from various indicators that are observable. In the case of parents' enthusiasm for reading, we have four indicators in the parents' questionnaire: "When you are at home, how much time do you spend reading for your own enjoyment?" (PA05Q01); "Reading is one of my favourite hobbies" (PA06Q01); "I

feel happy if I receive a book as a present" (PA06Q02); "I enjoy going to a book store or a library" (PA06Q04). We verified that these are in fact four related indicators, and that it is reliable to assume that they are reflecting the behaviour of a latent variable. Finally, we estimated for each student the value of that variable not directly observed. For this we use, as does the OECD, the theory of response to the item. Specifically, as our items have more than two categories, we use a generalisation of the Rash model, the generalised partial credit model (GPCM) proposed by Muraki (1992), which is the most appropriate in the context of our study because it allows discrimination to vary between items (OECD, 2017, p. 291) to construct a new index. See Appendix for a detailed explanation.

From these results, we can conclude that there is internal coherence in the scale found, that the four variables observed manifest an unobserved latent variable and that the model estimated by the GPCM method can be used to generate, *a posteriori*, a plausible value, an estimate of the parents' enthusiasm for reading, based on their characteristics.

The variable thus generated is a scale that we can standardise, following the usual OECD procedure for its derived variables so that the entire population under study has a mean equal to zero and a standard deviation equal to one. We have included only the parents who answered at least two of the observed variables. By country, once all the calculations have been made, the distribution of the response variable in our study is presented in the Figure 1.

The largest median is in Germany, and the lowest in Portugal. The smallest interquartile difference occurs in Hungary, where the difference between the first quartile and the median is very narrow. Both in this country and in Italy, there are some atypical values, or outliers, seen in the upper part of the distribution. This variable enters in the model recoded: we decided to give value 1 to those students whose parents are in the third quantile of enthusiasm, and 0 to those with parents on the first quantile: we compare both groups for each country.

As a descriptive analysis, we compare the mean difference in reading comprehension between a treatment and control group. The positive difference for the treatment group in all countries is strong indicator that permits us to intuit a positive general impact in reading of the parent's pleasure for reading. Moreover, it is a signal of the relevance of the treatment variable. This result is in line with the results shown by Mullis *et al.* (2017) with PIRLS. See Table 1.
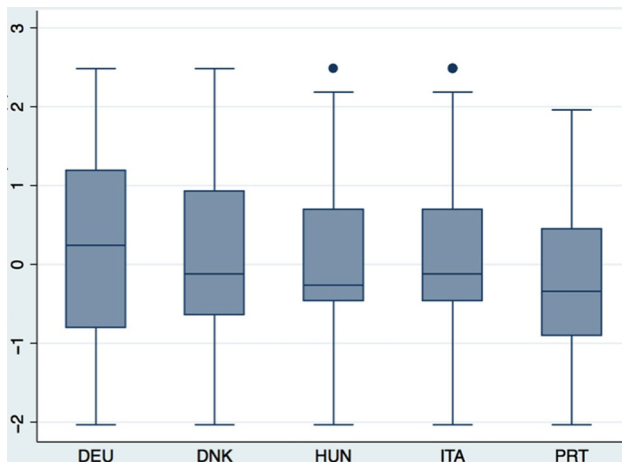

Figure 1.
Box diagram for the distribution of "parents' enthusiasm for reading" in each country

3.2.3 The control variables. Along with the treatment, the other explanatory variables are the control variables. The information for these variables comes directly from the context questionnaire filled out by the students and parents. We choose the control variables following the empirical literature on PISA database. Among the variables used for students are their immigrant status, their reading habit, if they attended pre-primary school, the educational level of their parents or if they repeated a high school course. Table 2 shows the variables selected.

In the context questionnaire of the students, young people were asked about the time they spent reading for pleasure when they were at home. The answers allowed some gradation in the response according to how much time they spent, but in our study, we recoded it and the variable "children reading" is divided into two categories: students who do not read 0, and those who read something daily 1.

Group	Germany	Denmark	Hungary	Italy	Portugal
Treatment group	532.88	514.24	522.67	517.17	518.20
Control group	484.79	485.67	476.32	477.44	479.34
Mean difference	48.09***	28.56***	46.35***	39.72***	38.85***

Note: *** $p < 0.01$

Table 1.
Reading
comprehension.
Mean–comparison
test

ITEM	Variable	N	Average/Pct.	SD	CODING
ST23Q01	Children reading	51,857	66.26%		0 = Do not read for pleasure every day 1 = Read for pleasure on a daily basis
ST04Q01	Female	52,711	49.84%		0 = Male 1 = Female
IMMIG	Immigrant	51,672	1.1196	0.4310	1 = Native 2= Immigrant second generation 3 = Immigrant first generation
ST05Q01	Early childhood education	51,613	82.14%		0 = Do not attend 1 = Attend
ST07Q02	Repetition	48,450	6.48%		0 = Have not repeated a high school course year 1 = Have repeated one year or more
PQHISCED	Parents' education	42,688	1.5431	1.1173	0 = Secondary or lower 1 = Baccalaureate or similar 2 = Post-secondary not higher education 3 = Higher education or university
ST19Q01	Language spoken at home	47,821	13.57%		0 = The same as the test language 1= Other language

Table 2.
Description of the
explanatory
variables of the
model

The immigrant variable takes three values:

(1) when the student is native (88.81% for all countries);

(2) when the student is a second-generation immigrant, i.e. it was the parents who emigrated and the children were born in the country (6.53%); and

(3) indicates first-generation immigrants, those who have just arrived in the country (4.65%).

The variable early childhood education includes whether the student, before primary school, attended class at ISCED level 0, which represents schooling attended between the ages of 3 and 6; in some countries, the parents can choose whether to send their children to school at this age. For the whole sample, 83.64% attended, but there are differences, ranging from 60.21% in Portugal to 94.50% in Hungary.

The variable "repetition" refers to students who repeated secondary education for one or more years. We are interested in introducing a control variable to characterise a student with learning problems. This variable is closely linked to the educational system of each country and the conditions that must be met for a student to not be suspended.

The parental context questionnaire has several measures on their educational level. In our study, for the "parents' education" variable, the maximum educational level reached by the mother or the father, using the same categories as the OECD, is 0, if their level of education is lower than the ISCED 3; (1), if their level is ISCED4; (2), if the maximum level is ISCED5; and (3), if they reached ISCED 5 A or 6 levels.

The variable "language spoken at home" indicates whether the language spoken at home coincides 0 or not (1) with the language used in the PISA test. It is one more measure of the degree of integration of the immigrant and, in the case of reading, we understand that the language in which the family communicates at home is relevant.

Finally, we calculated the mean difference test between the treatment and control group. We could to note some difference on the control variables [7].

4. Results
Estimations made to determine whether the habit of reading by parents could influence the difference in performance between reading comprehension and mathematics of their children indicates that there is clearly a positive effect for four out of the five countries analysed (Table 3) [8].

The effect ranges from 4 points for Italy to 6.5 points in the case of Germany and Portugal. Regarding the significance of the effect, with the exception of Hungary where no effect is proven [9], all other countries show the result to be reliable and robust. Even so, it is remarkable that, after controlling through the methodological approach for multiple unobservable personal characteristics and for a series of theoretically relevant control variables, such a positive effect remains unchanged. Therefore, we can confirm the existence of an internal factor of families – such as the habit of daily reading – in the results observed in their children. In others words that the effect the parents role model play on child's preferences formation through imitation behaviours is positive to improve the reading for pleasure or gratuitous reading.

In reference to the control variables introduced in the model, it should be noted that their primary function is to allow the effect assigned to the treatment variable to be real and as tight as possible, and that in a "DiD" model, such variables should be included in those cases where it is considered that they can exert a differential effect in both competences (reading

Explanatory variables	Germany	Denmark	Hungary	Italy	Portugal
Treatment variable					
Parents read	6.599** (3. 336)	5.372** (2. 725)	4.586 (2.956)	4.183*** (1. 462)	6.591** (2. 964)
Control variables					
Children read	3.061 (3.551)	11.710*** (3. 337)	9.535*** (2. 956)	11.213*** (1. 740)	11.087*** (3. 083)
Female	56.491*** (3. 253)	43.431*** (3. 198)	48.442*** (2. 784)	56.762*** (1. 549)	46.389*** (2. 703)
Immigrant 0			(Reference Category)		
Immigrant 1	6.698 (7.050)	16.420* (9. 490)	8.863 (8.505)	-4.550 (8.487)	15.126* (8. 615)
Immigrant 2	5.740 (8.981)	15.258 (16.093)	-8.602 (11.550)	-7.956* (4. 729)	-3.061 (11.664)
Early childhood					
Education level 0			(Reference category)		
Early childhood					
Education level 1	3.164 (8.118)	-14.589 (12.634)	-12.115 (10.561)	4.114 (3.921)	1.209 (3.821)
Repetition 0			(Reference Category)		
Repetition 1	5.254 (5.944)	-11.169 (20.182)	-2.607 (8.261)	-5.537 (4.500)	6.654 (5.558)
Repetition 2	52.157** (20. 474)	-68.884* (38. 917)	-8.625 (13.500)	0.257 (23.536)	15.899 (12.193)
Parent's education level 0			(Reference Category)	(Reference Category)	
Parent's education level 1	-0.381 (11.804)	3.771 (6.614)	2.959 (3.327)	8.620*** (2. 091)	0.271 (3.247)
Parent's education level 2	1.753 (4.188)	3.970 (5.771)	3.156 (4.501)	7.218*** (2. 764)	-1.765 (6.357)
Parent's education level 3	-9.697** (4. 714)	6.453 (5.182)	1.133 (4.097)	9.566*** (2. 237)	-12.773*** (4. 581)
Language at home 0			(Reference category)		
Language at home 1	-6.831 (8.049)	-12.575 (10.997)	10.914 (13.163)	-10.193 (3.157)***	-18.595 (12.500)
	$N = 1,640$	$N = 1,875$	$N = 2,485$	$N = 13,302$	$N = 2,372$
	$R^2 = 0.250$	$R^2 = 0.175$	$R^2 = 0.251$	$R^2 = 0.247$	$R^2 = 0.195$

Notes: N = sample size; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 3.
Results of the
estimations.
Standard error in
brackets

comprehension and mathematics). That said, we would like to highlight several interesting results obtained.

First, the variable that indicates that children are readers (daily reading for pleasure) is seen to be a factor that positively affects the difference between reading and maths skills in four out of the five countries analysed. Apart from Germany, the other countries show a positive and very significant effect of between 9 and 11 points.

So, children reading would have an individual effect, separate from the effect of their parents' reading on the differential observed in PISA. A student reader with parent readers would have an aggregate differential effect of between 13 and 17.5 points, compared to other classmates without this consolidated habit.

Secondly, an expected result was the positive effect of being female on the reading–maths differential. Empirical literature has always shown that females have better performance in reading comprehension, and this is also reflected in our estimations.

Thirdly, the immigration variable shows a disparate result depending on the country analysed. In the case of Germany and Hungary, it is not significant, while it has a positive effect in Denmark and Portugal, and a negative effect in Italy (although, always with low significance). The effect observed is the differential in relation to the reference category, i.e. students who were born in their native country.

Fourthly, the maximum educational level of parents shows an effect in three of the countries evaluated, but not in Denmark and Hungary. Germany and Portugal show a negative impact in the case of parents with education higher than tertiary level. By contrast, for Italy, the impact is positive in all categories of the variable. It should be remembered that the reference category is compulsory or lower secondary-level education. In our study, this low global significance is surprising, considering the importance that parents' level of educational is given as a synthetic indicator of the social and cultural environment surrounding the student.

Fifthly, the language spoken at home being different from that used in the test is only relevant in the case of Italy, and with a negative sign. This result is expected because knowledge of the vehicular language in school is a central element in expected and observed levels of reading competence in the PISA tests. The general absence of impact of this variable indicates that its effect, if it exists, is relatively homogeneous for reading and maths skills. Attending early childhood education is not significant.

Finally, we replicate the estimation using as dependent variable, those formed by alternative differences: science–mathematics and reading–science. In the first option, the results indicated a positive impact (very similar than the main estimation). In the second option, we found non-impact. This result is very interesting because it shows a positive impact of the habit of reading by parents on the difference between reading and science in front of mathematics [10].

5. Conclusions and educational policy proposals

Based on the results for the five countries analysed, we can highlight two main points. First, it has been demonstrated that the reading enthusiasm of the parents helps to improve the disposition for gratuitously reading of their children.

Second, all countries in the sample, except Germany, show that the reading competence of a young person who has parents at home who like to read is further enhanced if the young person is also fond of reading.

That the children, at some age, do not obey but imitate, was already known. Our paper shows that it is also econometrically true when talking about reading attitudes: the presence of parents with enthusiasm for reading is a positive influence in the reading attitudes of their children without the need of force them to. The results are especially important because, first, they might inspire strategies based on something so common as the parents, and second, the

effect on the children could lead to a long-term change of habits for teenagers: once the student finishes his/her studies, he/she will still keep the reading just for pleasure.

The question we then ask is this: what could the educational authorities do to promote reading enthusiasm in parents and young people? As the OECD acknowledged in its 2010 report, changing student attitudes towards reading is even more difficult than ensuring equal access to good schools and good teachers for all. But, in view of our results, we would recommend strengthening parental support. In fact, some educational systems, such as those in the UK, Ireland or the USA, are introducing legislative changes so that schools involve parents more in the educational process.

Perhaps, rather than forcing parents to participate in school meetings, it would be better to help parents be good role models by implementing educational policies so that they are aware of their role in their children's learning, helping them to channel their desire to be better educators and better parents through the most appropriate reading strategies. In view of the trend already quantified in international reports of the loss of reading habits in adults, it is recommended to involve educational authorities in the activation of policies aimed at increasing reading at home. Perhaps, a reading club for parents in the school and better schedules for libraries could be two practical procedures promote the reading for pleasure in the parents.

Notes

1. For example, the data from the latest International Study of Progress in Reading Comprehension, PIRLS, leave no doubt about the relationship between parents' attitude towards reading and their children's educational performance. The average for elementary students whose parents say they "like to read" (which accounts for 32% of the total parents) is 535 points, compared to 488 on average for children whose parents do not like to read (accounting for 17%) (Mullis *et.al.,* 2017).

2. TEDS: Twins Early Development Study. This study follows twins born between January 1994 and December 1996 in England and Wales.

3. BCS70: British Cohort Study, a representative sample of British citizens who were born in a certain week of 1970 and who have been interviewed and "measured" periodically, the last time being in 2012.

4. The existence of endogeneity between the treatment effect ("parents' enthusiasm for reading") and the outcome variable (reading performance) constrasted by diferent tests (Hausman, Pindyck and Rubinfeld and Gujarati) forced us to chose a more sofisticated technique to grasp the expected causality.

5. Results are available upon request.

6. Other differences were possible as science and mathematics or reading and science. We calculated these estimations too as comparative results (see Section 3).

7. The results are available upon request.

8. We estimate the main model in case of the parent who answered the questionnaire was the mother or father (see in the Appendix Table A5).

9. It may be due to many causes, which cannot be covered in this study. Perhaps, the family situation and an educational system that replace parents in their task as role models may be two of the reasons.

10. The results are available upon request.

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Appendix

On the formation of the treatment variable
There are four indicators in the parents' questionnaire: "When you are at home, how much time do you spend reading for your own enjoyment?" (PA05Q01); "Reading is one of my favourite hobbies" (PA06Q01); "I feel happy if I receive a book as a present" (PA06Q02); "I enjoy going to a book store or a library" (PA06Q04) of parents' enthusiasm for reading. The first set is to verify that these are in fact four related indicators. To study the relationship between the four indicators, we use Kendall's Tau (τb) proposed by Kendall in 1945, which is the alternative to Pearson's linear correlation coefficient when it is assured that the variables do not follow a normal bivariate distribution, as in this case. Table A2 shows the intensity of the relationship between the four indicators of reader enthusiasm, measured by tau. As can be seen, all variables have a sufficiently high correlation to presume that they are measuring similar aspects of parental behaviour. That is, it makes sense to think that there is an unobserved variable that is partially manifesting itself in the four questions analysed.

Once the indicators have been described and there is shown to be a certain relationship between them, we build a scale, an index that represents the latent variable "reader enthusiasm". For this we use, as does the OECD, the theory of response to the item. Specifically, as our items have more than two categories, we use a generalisation of the Rash model, the GPCM proposed by Muraki (1992), which is the most appropriate in the context of our study because it allows discrimination to vary between items (OECD 2017, p. 291). The model expression is:

$$P\big(x_{j,i}|\theta_j,\ \alpha_i, \delta_r\big) = \frac{\exp\left(\sum_{r=0}^{r=k} \alpha_i(\theta_j - \delta_r)\right)}{\sum_{u=0}^{u=m_i} \exp\left(\sum_{r=0}^{r=u} \alpha_i(\theta_j - \delta_r)\right)} \tag{5}$$

where P(xj,i | θj,αi,δr) is the probability that a certain individual j chooses option r to item i. This probability depends on the value of the latent variable in that subject (θj), of the discriminant capacity of that item (αi) and of the item location parameter (δr). The estimations are made with the R package ltm (latent trait models under item response theory (IRT)) (Rizopoulos, 2006). Table A3 presents the results. As can be seen, there is the expected progressiveness in the parameters, and the item that most discriminates is the PA06Q01, corresponding to the statement: "Reading is one of my favourite hobbies".

The last step before generating the estimations of the latent variable "reader enthusiasm", based on the newly estimated parameters, it is necessary to verify that the scale formed by the four indicators is reliable, i.e. that it has an internal consistency within each country. To calculate internal consistency and determine whether the results are comparable between countries, the OECD uses Cronbach's α. For the countries under study, the value of the coefficient for the "parents' enthusiasm for reading" construct is showed in Table A4.

Reference	Data from	Approach	Method	Finding
Baker and Scher (2002)	65 six-year-olds (first graders) from different sociocultural backgrounds and their mothers	Children's motivation for reading in relation to parental beliefs and home literacy experiences	Correlation and descriptive statistics	Beginning readers had generally positive views about reading, and that no differences in motivation were associated with income level, ethnicity or gender. Empirical support was provided for the distinctness of the dimensions of value, enjoyment and perceived competence
Bradley et al. (2001)	US children. Age birth through age 13	Children exposed to various parental actions, including reading	Hierarchical linear modelling	Slightly stronger relations for younger as compared with older children. The strength of the associations varies by ethnicity, and poor versus non-poor children
Cardoso et al. (2008)	Time use survey (France, Germany and Italy)	Time allocation by parents and time allocation by youngsters	Fractional regression model, double hurdle model	Parental role models directly influence children behaviour
Cheema (2018)	PISA 2009 – 65 countries	Effect of enjoyment of reading on reading achievement	General linear model	Enjoyment of reading is positively associated with reading achievement in high academic performance countries and negatively associated in case of low academic performance countries
Chen (2008)	Secondary school students; samples of 9th and 12th graders of the Taiwan Education Panel Survey	Student were asked what kinds of activities they do on vacation. Those who reported reading a lot of extracurricular books were classified as avid readers	Chi-squared analysis and logistic regression	Parents and teachers do make a difference in children's reading habits
Coulon et al. (2011)	British cohort study (2004)	Relationship between parental cognitive skill in adulthood and children cognitive and non-cognitive skills in early childhood	OLS	Parents with better numeracy and literacy in adulthood have children who perform better in early cognitive and non-cognitive tests
Hemmerechts et al. (2016)	PIRLS 2006 – western European countries	Parental literacy activities with the child reading literacy by SES	Multilevel Analysis	Children with lower SES experience more late parental involvement in

(*continued*)

Reference	Data from	Approach	Method	Finding
Kalb and van Ours (2014)	Australia. LSAC. Children at age 4-5.	Parental reading to children	Bivariate ordered probit. Several sensitivity analyses	literacy activities that children with a higher SES Positive and significant effects on reading and cognitive skills at least up to age 11
Mancini et al. (2011)	Italian Time Use Survey	Reading habit (parents – children)	OLS intergenerational-type regression	Children are more likely to read and study when they live with parents that are used to read
Mullan (2010)	UKTUS 2000 – 2001	Association between parent's and young people's reading	OLS	Strong association in case of household where parents read for more than 30 min per day
Raikes et al. (2006)	USA. Age 14, 24 and 36 moths.	Low-income mothers reading daily to their children	Correlations and path analysis	Reciprocal relations between maternal book reading and children's vocabulary
Ritchie et al. (2015)	Twin pairs tested at 7, 9, 10, 12 and 16 years	Cross-lagged monozygotic differences design to test associations of earlier within-pair reading ability differences with subsequent intelligence differences	Correlations	The study highlights the potentially important influence of reading ability, driven by the non-shared environment, on intellectual development
Sullivan and Brown (2015)	UK. 16-years-old from BCS70	Reading and vocabulary tests	OLS	Reading is most strongly linked to progress in vocabulary, with a weaker, but still substantial link to progress in mathematics. Reading for pleasure is more strongly linked than parental education to cognitive progress in adolescence
Tizard et al. (1982)	Children (aged 6–7 years) in two classes in			Highly significant improvement by children who received extra practice

Reference	Data from	Approach	Method	Finding
	multiracial inner-city schools	For 2 years, the children regularly heard reading at home from books sent by the class teacher	Descriptive statistics and mean difference *t*-test	at home in comparison with control groups, but no comparable improvement by children who received extra help at school. The gains were made consistently by children of all ability levels

Table A1.

Table A2. Kendall's tau for the four indicators of the latent variable: "parents' enthusiasm for reading"	PA05Q01	PA06Q01	PA06Q02	PA06Q04
PA05Q01	1.0000	0.4306	0.3732	0.3677
PA06Q01	0.4306	1.0000	0.5939	0.5240
PA06Q02	0.3732	0.5939	1.0000	0.5452
PA06Q04	0.3677	0.5240	0.5452	1.0000

Table A3. Parameters of the "parents' enthusiasm for reading" index	ITEM	δ_{i1}	δ_{i2}	δ_{i3}	α_i
	PA05Q01	−1.6105	0.5922	1.2971	0.9134
	PA06Q01	−2.0592	−0.9938	0.5017	2.9286
	PA06Q02	−1.9546	−1.2301	0.3590	2.8183
	PA06Q04	−1.8511	−0.9898	0.7787	1.8640

Table A4. Cronbach's α for "parents' enthusiasm for reading" for each country	Country	Cronbach's α
	Germany	0.8404
	Denmark	0.8371
	Hungary	0.7984
	Italy	0.7899
	Portugal	0.8251

Addendum

The authors have re-estimated the main model taking into account whether the person answering the questionnaire is the mother or father for each country. In most countries, the authors found find a positive effect in the case of the mother having the habit of reading. On the contrary, the effect is not significant in the case of parents. This situation is reversed only in the case of Portugal. Moreover, in the case of mothers, the sample allowed estimating the effect of the *Parent read* for the specific case of daughters and sons. This has not been possible in the case of men because of presenting a very limited sample size. At the methodological level, we are left in doubt as to whether or not the responding parent consults with his or her partner when responding.

	Germany	Denmark	Hungary	Italy	Portugal
Case 1: Mother's respondents					
Mother's Parents Read	8.440** (3. 834) N = 1,370	8.165** (3. 511) N = 1,537	5.864* (3. 089) N = 2,082	4.449*** (1. 659) N = 10,598	3.890 (3.512) N = 1,854
Mother's respondents – daughters					
Parents Read	4.603 (4.850) N = 762	13.410*** (5. 319) N = 804	9.851** (4. 146) N = 1,090	7.231*** (2. 556) N = 5,697	2.416 (5.162) N = 1,079
Mother's respondents – sons					
Parents Read	12.710** (6. 563) N = 608	2.381 (4.663) N = 733	1.757 (4.998) N = 992	1.446 (2.417) N = 4,901	7.141 (5.737) N = 775
Case 2: Father's respondents					
Father's Parents Read	2.725 (10.195) N = 269	1.840 (11.581) N = 338	−2.914 (8.601) N = 400	2.755 (4.146) N = 2,704	13.811** (6. 211) N = 495

Notes: Standard error in brackets. Legend: N = sample size; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table A5.
Results of the estimations