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Social Capital and Mathematics Achievement of Fourth and Fifth Grade Children in Segregated Primary Schools

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ABSTRACT

Scholars have consistently demonstrated that the socioeconomic composition of the pupil body is related to academic achievement. The effect of ethnic/immigrant concentration, on the other hand, is more controversial, as some have found no impact of the ethnic/immigrant composition when other aspects were taken into account. Social capital theory claims that it is possible to compensate for a disadvantaged background or school composition when pupils benefit from being integrated in specific social structures. This article tests whether social capital is positively related to the mathematics achievement of pupils in the fourth and fifth grades of Flemish primary schools in which most of the pupils have a low socioeconomic and/or an ethnic/immigrant background (i.e. segregated schools).

1. Introduction

The continuing immigration in various Western European countries has recently triggered social and political concerns. Immigration creates new challenges for the education of coming generations. For instance, many policymakers worry about the growing school segregation (i.e. the concentration of pupils with a low socioeconomic and/or an immigrant background) happening in many European cities. The concentration of pupils with such background in specific schools is perceived as unfavourable for educational performance, but also as an obstruction to social integration and cohesion (Jenkins, Micklewright, & Schnepf, 2008). Scholars of education address these concerns with a large body of studies focusing on the effects of school compositional characteristics on student outcomes (for France: Boado, 2007; for Belgium: Agirdag, Van Houtte, & Van Avermaet, 2012; for the Netherlands: Van der Slik, Driessen, & De Bot, 2006; for Norway: Fekjær & Birkelund, 2007; for Sweden: Brannstrom, 2008). With a few exceptions, these studies have demonstrated that the socioeconomic composition of the pupil body is related to academic achievement. That is, pupils who attend schools with a higher share of socioeconomically disadvantaged children were found to perform worse (for a meta-analysis: see Van Ewijk & Slegers, 2010a). The effect of ethnic/immigrant concentration, on the other hand, has proven to be more controversial, as some researchers have found no impact of the ethnic/immigrant composition when other aspects were taken into account (for a meta-analysis: see Van Ewijk & Slegers, 2010b). As such, the net effect of ethnic school segregation on pupils' academic performance remains a topic of continuing debate and research.

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A recurring but highly neglected finding in these studies is the large variation in the academic performance within and between segregated schools. That is, not all segregated schools perform below average and some of the segregated schools even outperform elite schools (see Agirdag & Van Houtte, 2011). Furthermore, not all students in segregated schools perform below average and some perform above average. Given the lack of research that specifically focuses on these differences, it is not clear which elements distinguish students from high-performing segregated schools and students from the low-performing segregated schools. Examining the differences within and between segregated schools is not only important for the sake of scholarly analysis and knowledge accumulation. From a policy and practice perspective, it is also crucial to identify features that can make (a student in) a school with a disadvantaged composition successful.

A theoretical framework that is relevant in this regard is that of 'social capital' theory. This theory claims that it might be possible to compensate for a disadvantaged background or composition (e.g. financial or other forms of capital) when pupils benefit from being integrated in specific social structures (i.e. have access to social capital) within their family or school (Dika & Singh, 2002; Portes, 1998). A prominent advocate of social capital, Coleman, analysed students' academic achievement in terms of the effects of being in different social structures. He pointed out two forms of social capital: social capital in the family and social capital outside the family (Coleman & Hoffer, 1987; Coleman, Hoffer, & Kilgore, 1982; Hoffer, 1998). Social capital in the family is high when adults are physically present in the family. Their presence entails a higher possibility that children can access available family resources (information, support, etc.). According to this perspective, families with more siblings and single parent families are bound to have lower levels of social capital (Coleman, 1988). In Coleman's view, student's relation with adult networks at school may provide 'intergenerational closure'. Students are then part of a broader parental network that surrounds the school, which he classifies as 'social capital outside the family'. Membership in such networks has its benefits, insofar as students can access its available resources (information, support, etc.). Parents in such networks also have access to the resources (information, support, etc.) of other parents, which allows them better monitoring and control of their children (Coleman, 1988).

Studies using the Coleman framework in an educational setting have focused on analysing the possible effects of social capital on educational achievement (see Carbonaro, 1998; Hoffer, 1998; Israel, Beaulieu, & Hartless, 2001; Morgan & Todd, 2009). Authors have also examined the effects of social capital on academic achievement for students with and without a minority and/or immigrant background (see Bankston, 2004; Kao, 2004; Kao & Rutherford, 2007). However, research has mainly focused on children in schools without making the distinction between segregated and non-segregated schools. More specifically, it has not investigated whether Coleman's social capital theory holds among students with an immigrant and/or low socioeconomic background embedded in a segregated learning context. This is unfortunate because Coleman's contribution has emphasized the advantages of being integrated in a social network to counteract the possible lack of (material) resources that these students might have (see also Agirdag, Van Houtte, & Van Avermaet, 2012; Driessen, 2002; Kao & Rutherford, 2007; Massey & Fischer, 2006; Rumberger & Palardy, 2005).

In this article we focus on the school system in Flanders (in the upper part of Belgium). The reasons for this focus are three-fold. Firstly, the Flemish school system exhibits relatively high educational inequality compared with school systems in other European countries (Jenkins, Micklewright, & Schnepf, 2008). Secondly, school segregation within Belgium has become a source of concern in recent years (Nusche, Miron, Santiago, & Teese, 2015; Vlaamse Onderwijsraad, 2014). More specifically, research has found that in the Flemish school system, students with a particular socio-economic and ethnic background tend to be unequally distributed between schools (Agirdag, Van Houtte, & Van Avermaet, 2012; Jacobs, Rea, & Hanquinet, 2007; Jacobs, Rea, Teney, Callier, & Lothaire, 2009; Wouters & Groenez, 2013). Thirdly, these students with a disadvantaged background also tend to lag behind in terms of academic achievement (European Commission, 2016; Jacobs & Rea, 2011). If we consider the relatively high segregation and educational inequality of students in the Flemish school system (Agirdag, Van Avermaet & Van Houtte, 2013), it would be interesting to investigate the effects of social capital in this setting. This article therefore contributes to the literature by testing whether

social capital is related to the academic achievement of Flemish primary school children who are taught in schools in which most of the students have a low socioeconomic and/or an ethnic/immigrant background (i.e. segregated schools).

2. Theoretical framework

2.1. Introduction

The concept of social capital means that “relationships matter” and provide additional resources (Field, 2008, p. 1). Contemporary formulations of this concept in educational science start with Bourdieu and Coleman. Both authors are influential in further applications of social capital in this domain of research (Dika & Singh, 2002). Coleman specifically designed his social capital theory in order to explain academic achievement. In this article, we will therefore only focus on Coleman’s social capital theory.

Coleman described social capital as “a particular resource available to an actor” that might help to achieve certain goals and fulfill ambitions (1988, p. 98). He defined social capital by the function of this resource “with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors – whether persons or corporate actors – within the structure” (1988, p. 98). Social capital is not the possession of one individual – it resides in the relationships between people. Social capital is therefore not a fixed asset or thing that people can acquire.

Although Coleman developed his theory on social capital with data on schools in the United States, research has further investigated and enriched his argument. This includes research on the number of siblings, the family structure and intergenerational closure in Western Europe and the United States (e.g. Bankston & Zhou, 2002; Carbonaro, 1998; Carolan, 2012; Corten & Dronkers, 2005; Dufur, Parcel, & Troutman, 2013; Goddard, 2003; Kreidl & Hubatkova, 2014; Morgan & Sorensen, 1999; Morgan & Todd, 2009; Sandefur, Meier, & Campbell, 2006; Schlee, Mullis, & Shriner, 2009; Slates, Alexander, Entwisle, & Olson, 2012; Van Houtte, 2004; Woolley, Kol, & Bowen, 2009) and non-Western contexts (Eng, 2013). Coleman’s distinction between two main forms of social capital are directly relevant to explaining academic achievement: social capital in the family (section 2.2) and outside the family (section 2.3).

2.2. Social capital in the family

Coleman identified single parents and the number of siblings as negative elements that inhibit academic success (1988). Coleman’s theory is similar to the resource dilution theory that also focuses on family size and academic achievement (Blake, 1981). The theory of Coleman and the resource dilution theory postulate that an increase of siblings or a decrease of adult persons in the family results in less access to family resources (such as the financial capital). According to this account, because these resources are not infinite, children in families who have less access to family resources tend to have lower chances of developing themselves academically (Chapple, 2009; Downey, 1995; Steelman, Powell, Werum, & Carter, 2002; Sylva, 2014).

Most research in Western Europe and the United States in the past decades has reported a negative association between sibship size, single parent families and academic achievement (Baydar, Greek, & Brooks-Gunn, 1997; Chapple, 2009; Downey, 1995; Steelman, Powell, Werum, & Carter, 2002). For example, Kreidl and Hubatkova (2014) documented a negative association between sibship size, single parent families and academic achievement in 40 countries using data of the Programme for International Student Assessment (PISA) (the wave of 2000). They found that students with more brothers and/or sisters and children who have a single parent perform worse on the reading literacy test (see Kreidl & Hubatkova, 2014, p. 11). Similarly, Pong, Dronkers, and Hampden-Thompson (2003) found that single parenthood has a negative association with mathematics and science achievement. They used data on eleven countries of the International Math and Science Study (TIMSS, wave three).

However, a small number of scholars have questioned the resource dilution theory (Stelman, Powell, Werum, & Carter, 2002) and therefore Coleman’s theory of social capital in the family and its

explanation of academic achievement. Some scholars have claimed that the relation between family size and academic achievement might be spurious (e.g. Chapple, 2009; Guo & Van Wey, 1999; Sandberg & Rafail, 2014). They claimed that unmeasured elements related to family size and academic achievement such as parental socioeconomic status and cognitive ability confound this relation. Although the majority of research has supported a negative relation between family size and academic achievement, there are reasons to further investigate this purported association in a longitudinal research design and among disadvantaged students. We do this by including possible confounders. In this article, we hypothesize that

H1: The number of siblings in a family is negatively related with children's academic achievement.

H2: Children who live in a single-parent family are more likely to have lower academic achievement than children who live in another family structure.

2.3. Social capital outside the family

Studies of Coleman and Hoffer (1987) and Hoffer (1998), compare the performance of high school students in schools in the United States. In these studies, the school performance of high school students was better in Catholic private schools (Corten & Dronkers, 2005, Parcel, Dufur, & Zito, 2010; Hallinan & Kubitschek, 2012; Morgan & Sorensen, 1999). In these studies, it was shown that students' relationship with adult networks provided 'intergenerational closure' and better academic performance. This form of closure exists when students are part of a broader parental network that surrounds the school. Membership in such a network has its benefits: students can access the available resources (information, support, etc.) of the network and other connected networks of the other members (Coleman, 1988, pp. 113–116). Parents in such networks also have access to the resources (information, support, etc.) of other parents, which allows them to better monitor and control their children's progress.

The existence of intergenerational closure among students and its association with academic achievement has been researched. For example, a study of Carbonaro using data from the National Education Longitudinal Study in the United States (1998) investigated whether intergenerational closure has an effect on academic achievement. The authors found that 12th grade math achievement was significantly and positively related with this form of closure on the student level (under control of socio-demographic variables and parental involvement/expectations). This effect became insignificant after controlling for negative signs of integration at school (absenteeism, deviant behaviour at school and having friends who are dropouts). Thorlindsson, Bjarnason, and Sigfusdottir (2007) showed with data of a survey of Icelandic adolescents (9th grade and 10th grade) that intergenerational closure is positively associated with math achievement. It also became insignificant after controlling for socio-demographic variables and parental and adolescent relations. In order to test whether intergenerational closure indeed has an effect on academic achievement in this article, we hypothesize that:

H3: Intergenerational closure of children at the individual level is positively related with children's academic achievement.

When intergenerational closure exists, children within such closed networks are more likely not only to know other children at school, but also to be more 'integrated' and have more contact with them. The formulation of the effects of intergenerational closure resembles Durkheim's theory on the social integration of members in a group. Despite the similarities between Coleman's theory on social capital and Durkheim's theory on social integration, these theories also have marked differences. Although Coleman recognized the public character of social capital, he took the individual as his theoretical starting point, whereas Durkheim emphasizes the collective level (e.g. the union of individuals in a group) more strongly than the individual level itself ([1901] 1982, pp. 39–40).

Research has shown that the effect of intergenerational closure on academic achievement can be different at the school level. Some studies have found a negative association between academic achievement and intergenerational closure at the school level. This has also been called the "dark side of social closure", where networks that are too dense have a negative effect on academic achievement (Carolan,

2012, p. 585). For example, Morgan and Sorensen (1999) distinguished between norm-enforcing and horizon-expanding schools. In the former, parents are strongly connected with other parents at school. The authors argue that these schools can “become suffocating communities in which excessive monitoring represses creativity and exceptional achievement” (1999, p. 663). In horizon-expanding schools, parents do not have that many connections with other parents at school. Morgan and Sorensen show with the use of data of the National Education Longitudinal Study in the United States that intergenerational closure at the school level is connected with worse achievement in mathematics. Later, Morgan and Todd (2009) found with data of the education longitudinal study that intergenerational closure has an effect on 10th and 12th grade mathematics achievement for Catholic schools after controlling for socio-demographic variables, students’ networks and school characteristics.

The argument that social capital might have fewer beneficial aspects in certain contexts is reminiscent of Burt’s theoretical work on structural holes and social closure. Burt (2000; 2005) argued that social closure could result in dense networks that include redundant information and possibly isolate its members. In other words, when networks become too dense, while being connected still has a positive effect on the individual level, a negative effect on academic achievement might exist on an aggregate level. We therefore hypothesize that

H4: Intergenerational closure of children at the school level is negatively related with their academic achievement.

3. Methodology

3.1. Sample selection

In this article, we use data that was collected in the P.IEO study (Project ‘Innovating and Excelling in Education’). The project focused on primary schools that have a high number of children with a non-native and/or a low socioeconomic background. In this article, we focus on children in the fourth and fifth grades of primary school in Flanders. For these students we have measurements of the level of social capital at home and at school. In the school years of 2013–14 and 2014–15, the children were tested on well-being and achievement: in September 2013, in April–May 2014 and in April–May 2015.

In Belgium, children are obligated to follow education from the age of 6 until the age of 18 (Baysu & de Valk, 2012). The Belgian school system uses a hierarchical tracking system of students (Phalet, Deboosere, & Bastiaenssen, 2007). In this school system, primary education normally lasts six years with a transition to secondary education at the theoretical age of 12. Mainstream secondary education in Belgium includes three stages that normally take two years each (De Groof & Franck, 2013). Enrollment in this school system is driven by the principle of parental freedom of school choice.

The administration of the Belgian school system is divided among three language communities (i.e., the Flemish, French and German speaking community). The Belgian school system is a highly segregated school system that is cut along linguistic lines. However, school segregation is not only exclusive between but also within regions (Nusche, Miron, Santiago, & Teese, 2015). In this study, we focus on the situation of the Flemish school system. Research on segregation in the Flemish school system has shown that this is a pattern explained by both parental freedom of school choice and residential segregation in Flemish cities (e.g. Wouters & Groenez, 2014).

In the P.IEO project, segregated primary schools were selected in two stages. In the first stage of sample selection, twelve schools (half of the sample) were selected by the Flemish department of education, as they were deemed convenient with regards to their socioeconomic and non-native composition. In the second stage of sample selection, the research team purposively selected twelve other schools that were similar in composition and context to the schools to which they were matched. They were situated in the same region in Flanders, Belgium (Ghent, Limburg, Brussels or Antwerp), were similar on socioeconomic and non-native composition, were in the same educational network (including subsidized official schools, subsidized private schools and community schools) and had a comparable school size and level of grade retention (see also Burny, Dewulf, Hemmerchts, & Goossens, 2015).

The resulting sample is not a representative sample of the primary school system in Flanders, however, it is representative for other similarly segregated primary schools in the region/province of East-Flanders, Limburg, Brussels or Antwerp with regard to two specific composition variables: the percentage of children with a mother without a higher secondary degree and the percentage of children of which no or only one family member in a family consisting of three people (excluding the child) speaks the language of instruction (Dutch) at home (population data provided by the Flemish department of education).¹ We found with goodness-of-fit chi square tests that the distributions of the composition variables in the population of non-selected similarly segregated schools ($\geq 48\%$ low maternal educational level or $\geq 47\%$ non-Dutch speakers at home) are equal to the distributions of the selected segregated schools (respectively $\chi^2 = 4.64$, $df = 3$, ns; $\chi^2 = 1.33$, $df = 3$, ns) (see [Figure 1](#) to see how our sample of schools is situated in the population of Flemish primary schools in these provinces/regions).

In [Table 1](#), we compare the observed distributions of both composition variables (X_i and Y_i) in the population of non-selected segregated schools with the observed distributions of the sample of schools. We classified the non-selected segregated schools in the population into four equal parts on the basis of each composition variable and calculated the observed percentage for each part. We then used these equal parts to calculate the expected frequencies (E_i) of the schools of the sample in those parts. We then apply the formula of the test statistic (see [Table 1](#)) twice to test the hypothesis whether the distributions of the composition variables in the sample are equal to the distributions of the non-selected segregated schools.

3.2. Variables

3.2.1. Outcome variable

The outcome variable is mathematics achievement in wave one, two and three of this project (September 2013, April/May 2014 & 2015). We administered mathematics tests designed for the Flemish population of children in the fourth and fifth grades (see also [Schoolfeedbackproject, 2014](#)). They were administered in the classroom and included problem solving, number knowledge and elementary arithmetic operations (including addition, subtraction, fractions, divisions and decimals). The wave two test (with 50 items) and wave three test (with 61 items) were constructed as follow-ups of the first wave test (with 60 items). The Pearson correlation between the sum scores of the first and second test is 0.81 ($n_{listwise} = 341$; $p < .001$), between the sum scores of the first and third test is 0.72 ($n_{listwise} = 346$; $p < .001$), and between the sum scores of the second and third test is 0.76 ($n_{listwise} = 356$; $p < .001$). Cronbach's alpha is 0.93 for the first and second wave and 0.94 for the third wave test ($n_{listwise}^{1st\ wave} = 352$; $n_{listwise}^{2nd\ wave} = 362$; $n_{listwise}^{3rd\ wave} = 366$). We used item response theory and the theta parameterization of Mplus 7.3 to execute a concurrent calibration with items that were common and unique to the waves (in a single group design) ([Muthén & Muthén, 2012](#)). More specifically, the common items were used to put the three tests on the same scale. We did this because otherwise we would not have comparable mathematics scores for each student. We calculated three sets of scores on a common scale from 0 (lowest score) to 10 (highest score) for those students who had mathematics scores on all three waves. In Mplus, we calculated equalities for the common items of each wave. We also imposed threshold invariance on the common items. The three theta variables are correlated.

3.2.2. Student level variables

At the student level, we include *background information* on gender, maternal educational level, monthly family income, social exclusion at school, employment situation of parents, parental educational expectations, parental school involvement and language spoken at home.

The information on the maternal educational level has been assembled with the use of information that was handed over by the schools and parents in a parental questionnaire during wave one. Maternal educational level is coded from no primary school (0), primary school (1), lower secondary school (2),

¹Brothers and sisters were counted as one family member by the Flemish Department of Education.

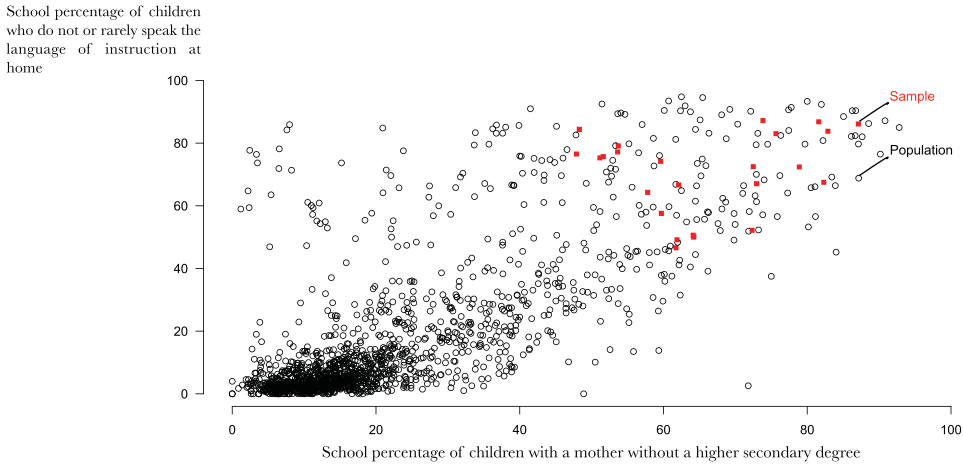


Figure 1. Scatterplot of the population and sample of Flemish primary schools, Note: data source = Flemish Department of Education, year = 2012, own calculations.

higher secondary school (3) and higher education (4). Because this variable has a low variability (most mothers in the sample are low educated: mean = 1.77; SD = 1.15; $n_{listwise} = 336$), we dichotomized this variable to distinguish between the people without a higher secondary degree and those with at least a higher secondary degree.

Some background variables were distilled from questionnaires filled in by the children: gender, social exclusion at school and language at home. Gender was coded as female (0) and male (1). The variable language at home measures whether children speak the language of instruction with at least one of their parents (collected in wave two). This type of variable is also partly used by the Flemish Department of Education to distinguish schools by immigrant background (Vlaamse Onderwijsraad, 2014). Pupils with a non-Belgian nationality and pupils with a Belgian nationality who do not speak Dutch as their home language are included in this variable. The variable language at home is coded in two categories (yes = 0; no = 1).

We constructed two measures on family structure that serve as *social capital in the family*: 1) single parent families (only the father or mother is present or perceived to be present at home = 1; families where the father and mother are present or perceived to be present at home = 0), 2) the number of

Table 1. Goodness of fit chi-square representativeness tests.

	N in sample (X_i)	N in population (Y_i)	Proportion in population (Z_i)	Expected frequency in sample ($E_i = 24 \cdot Z_i$)	$\frac{(X_i - E_i)^2}{E_i}$
A) % of children with a lowly educated mother at school					
1. [48% – 54.88%]	6	43	0.246	5.90	0.001
2.] 54.88% – 61.96%]	5	44	0.251	6.02	0.17
3.]61.96% – 71.94%]	3	45	0.257	6.17	1.63
4.]71.94% – maximum]	10	43	0.246	5.90	2.84
Total	24	175	1	24	4.64 (df = 3; p = 0.20)
B) % of children at school who do not or rarely speak the language of instruction at home					
1. [47% – 58.02%]	6	51	0.25	6	0
2.]58.02% – 68.55%]	4	51	0.25	6	0.67
3.]68.55% – 81.01%]	8	51	0.25	6	0.67
4.]81.01% – maximum]	6	51	0.25	6	0
Total	24	204	1	24	1.33 (df = 3; p = 0.72)

Note: data source = Flemish Department of Education, year = 2012, own calculations.

siblings (going from 0 to 4 or more siblings, the category 4 indicates four or more siblings). This information was collected in wave one.

We also have a measure of *social capital in school*. We measure the extent of networks that children have with other parents. Children were asked whether they know parents of other children in their own classroom and outside the classroom. This is our own conceptualization to measure intergenerational networks. We are specifically focused on networks that are extensive. Most of the children have networks that are classroom-based. To specifically distinguish highly networked children in school and therefore those children that are more likely to have high levels of intergenerational closure, we decided to indicate the presence or absence of networks that are classroom-based (networks with parents of children in their own classroom or with parents of children in another classroom) and those networks that go beyond one classroom. The variable is coded as no or only networks in the own classroom or outside the own classroom (0) and networks that are outside and inside the classroom: an extensive network at school (1). This variable was measured in wave two of this study. We also have a social inclusion at school index (collected in wave one). Students were asked whether they were bullied, called names, excluded and had quarrels at school. We constructed a social exclusion at school index. It is coded as 0 (none of these were experienced), 1 (one of these were experienced), 2 (two of these were experienced), 3 (three of these were experienced) and 4 (all were experienced).

The remaining variables were distilled from a parental questionnaire (collected in wave one). Monthly family income is coded from less than 1000 euros (0), 1000–2000 euros (1), 2000–3000 euros (2), 3000–4000 euros (3) and 4000 euros or more (4). Because this variable has a low variability (most have a low monthly family income: mean = 1.42; SD = 0.73; $n_{listwise} = 238$), we dichotomized this variable to distinguish between the people with a low monthly family income (less than 1000–2000 euros) and those with a higher monthly family income (2000–4000 euros or more). We also have a variable on the employment situation of parents. It is coded as 0 (no two persons who work fulltime), 1 (one person that works fulltime) and 2 (two persons that work fulltime). Parental educational expectations are measured by the following question: “my child will be able to follow this level of secondary education”. Parents could choose four categories: general secondary education (0), vocational secondary education (1), artistic secondary education (2) and technical secondary education (3). In Belgium, there is, however, a negative perception of vocational and technical tracks (Van Houtte & Stevens, 2010). To clearly contrast people with the highest and relatively lower expectations, we therefore dichotomized this variable. Parents who answered general secondary education were coded as 1. All the other categories were coded as 0. Parental school involvement is measured by three questions: “are you (or your partner) involved in the parent association of the school?”, “do you (or your partner) attend school activities for parents, for example an annual school party?”, “do you (or your partner) volunteer in school activities like the annual school party or banquet?”. We constructed a parental school involvement index. It is coded as 0 (none of these activities are done), 1 (one of these activities are done), 2 (two of these activities are done) and 3 (all are done).

3.2.3. Classroom level variables

At the classroom level, we use two composition variables that are based on the characteristics of students at wave one: the parental educational level and language composition. The parental educational level composition variable is the fifth grade classroom percentage of children with a mother who does not possess a higher secondary degree. A higher score on this variable indicates a lower parental educational level composition. The language composition variable is the fifth grade classroom percentage of children who do not speak the language of instruction (Dutch) with one of their parents. We classroom mean centred both composition variables.

We also measured the extent of intergenerational closure. This aggregated variable is based on information that was collected during wave two of this study. We used the fifth grade classroom percentage of the children who know parents of friends in the classroom and in other classrooms in school at wave two (the variable was only collected at wave two). A higher percentage indicates more extensive intergenerational closure of children. We mean centred this composition variable on the classroom level. These three variables are aggregations of the corresponding level 1 variables.

Table 2. Descriptive statistics of the variables.

<i>Variables</i>	<i>Range</i>	<i>N</i>	<i>Pooled mean or % (SD)</i>	<i>% imputed</i>
Student level				
<i>Background characteristics</i>				
1. Male	0–1	376	47.47%	0.80%
2. Low level of maternal education	0–1	376	65.90%	10.64%
3. No Dutch spoken at home	0–1	376	20.61%	3.46%
4. Low monthly family income	0–1	376	57.58%	36.70%
5. Social exclusion at school index	0–4	376	2.43 (1.44)	
<i>Bullied</i>	0–1		62.13%	7.98%
<i>Called names</i>	0–1		55.59%	7.98%
<i>Excluded</i>	0–1		48.67%	7.98%
<i>Quarreling</i>	0–1		76.44%	7.45%
6. School parental involvement index	0–3	376	2.11 (1.00)	
<i>Involvement in parent association</i>	0–1		66.81%	35.90%
<i>Attending school activities</i>	0–1		81.57%	39.63%
<i>Volunteering in school activities</i>	0–1		62.58%	35.90%
7. High parental educational expectations	0–1	376	62.05%	39.36%
8. Employment situation of parents	0–2	376	0.71 (0.59)	
<i>Full-time job of father</i>	0–1		53.67%	36.97%
<i>Full-time job of mother</i>	0–1		17.66%	37.76%
<i>Social capital characteristics</i>				
9. Single parent family	0–1	376	11.33%	6.12%
10. Number of brothers/sisters	0–4	376	2.30 (1.15)	8.51%
11. Intergenerational closure at school	0–1	376	35.27%	5.05%
<i>Outcome variables</i>				
12. IRT mathematics achievement (wave 1)	0–10	376	5.06 (1.53)	10.64%
13. IRT mathematics achievement (wave 2)	0–10	376	5.94 (1.74)	10.64%
14. IRT mathematics achievement (wave 3)	0–10	376	5.87 (1.68)	10.64%
Classroom level				
15. Low level of maternal education (classroom %)	36.15–98.57%	24	66.42% (17.31)	4.17%
16. No Dutch spoken at home (classroom %)	4.55–60%	24	21.38% (15.12)	0%
17. Intergenerational closure at school (classroom %)	9.17–73.33%	24	35.20% (15.81)	0%

We use multiple imputation to deal with missing values. The advantage of multiple imputation is that the available information of cases in the first, second and third waves can be used to impute the missing data: no information is neglected. It produces several datasets with the use of Bayesian statistics and analyses with these data are pooled to produce estimates (Enders, 2010). We use ten imputed datasets and have complete and balanced data for each student. In the imputation phase, we used all student level variables that were overviewed in this section, including for example also the scores on reading, listening and cognitive ability tests, the classroom identification variable and information on school administration (private sector or not). The models converged: we plotted the summary statistics (mean and standard deviation) for each scale variable for each iteration and imputation. After multiple imputation, we have data on 376 students in 24 fifth grade classrooms (one classroom in one school).²

3.3. Research design

Three level longitudinal mixed model specifications were used to account for the variation within mathematics achievement throughout the three waves of the study (*t*) (the first level of

²We used the information of children in fifth grade classes included in this study that were present in all waves and children in included fifth grade classes for which we do not have data for all the waves but who, according to the school administration lists, should have been present in all three waves. Both groups of children have missing values. The level of missingness is reported in Table 2. We have 376 children in included fifth grade classes that are in the school administration lists of all waves. We compare their last wave mathematics scores with the scores of children in the last wave (42) that were not included in this group of 376. There were insignificant differences ($p > .05$) between both groups (tested with an independent t-test with 42 versus 366 students). Six children who, according to the school administration lists, should have been present in all three waves had missing information on almost every variable. They are excluded from analysis.

analysis: time), of students (i) (the student or second level of analysis) and among the classrooms (j) (the classroom or third level of analysis) (Gelman & Hill, 2007; Hoffman, 2015; Hox, 2010). The analyses were carried out with SPSS 21 and restricted maximum likelihood estimation.

We opted to model mathematics with a quadratic time effect (i.e. a polynomial model) because 1) the mean mathematics achievement follows a non-linear path (the mean is higher in wave two compared to wave one and lower in wave three compared to wave two) and 2) a polynomial model gave a good fitting model for time. With three waves of mathematics achievement, the highest possible polynomial model is a fixed quadratic effect, random time slope model. We use this type of model in the analyses that are reported in Table 3, 4 and 5. We use the last wave as time zero. With interactions of the time effects and social capital variables, the main effects of the social capital variables are the effects on the mathematics achievement in the last wave. We also model the variances and covariances among random intercepts and slopes. The general form of the equations with n variables is:

Level 1 time

$$y_{tij} = \beta_{0ij} + \beta_{1ij}(\text{Time}_{tij}) + \beta_{2ij}(\text{Time}_{tij})^2 + e_{tij}$$

Table 3. Multilevel longitudinal models: estimates with standard errors in parentheses.

	<i>Model 1: only time</i>	<i>Model 2: background + family social capital</i>	<i>Model 3: background + social capital at school</i>
Intercept	5.86 (0.19)***	6.13 (0.29)***	5.77 (0.24)***
Linear Time Slope	0.54 (0.10)***	0.71 (0.20)***	0.49 (0.12)***
Quadratic Time Slope	-0.47 (0.04)***	-0.57 (0.09)***	-0.45 (0.05)***
Variance components			
Classroom Random Intercept Variance $\tau_{V_{00}}^2$	0.75 (0.26)**	0.80 (0.28)**	0.81 (0.29)**
Classroom Intercept-Linear Covariance $\tau_{U_{00},10}$	-0.16 (0.07)*	-0.18 (0.07)*	-0.18 (0.08)*
Classroom Random Linear Slope Variance $\tau_{V_{10}}^2$	0.07 (0.03)**	0.08 (0.03)**	0.08 (0.03)**
Student Random Intercept Variance $\tau_{U_{00}}^2$	1.89 (0.17)***	1.71 (0.15)***	1.69 (0.15)***
Student Intercept-Linear Covariance $\tau_{U_{00},10}$	-0.10 (0.05)*	-0.09 (0.04)*	-0.09 (0.04)*
Student Random Linear Slope Variance $\tau_{U_{10}}^2$	0.09 (0.03)***	0.09 (0.03)***	0.09 (0.03)***
Residual Variance σ_e^2	0.34 (0.03)***	0.33 (0.03)***	0.34 (0.03)***
% total explained variance	5.52%	13.10%	14.36%
Background characteristics			
Male		0.66 (0.14)***	0.68 (0.14)***
Low level of maternal education		-0.41 (0.17)*	-0.43 (0.17)*
No Dutch spoken at home		-0.39 (0.18)*	-0.37 (0.18)*
Social capital characteristics			
Single parent family		-0.28 (0.25)	
Number of brothers/sisters		-0.09 (0.07)	
Linear time slope * Single parent family		-0.57 (0.25)*	
Quadratic time slope * Single parent family		0.31 (0.12)*	
Linear time slope * Sibship size		-0.04 (0.07)	
Quadratic time slope * Sibship size		0.03 (0.03)	
Intergenerational closure (student level)			0.38 (0.17)*
Linear time slope * Intergenerational closure			0.15 (0.18)
Quadratic time slope * Intergenerational closure			-0.05 (0.08)
Classroom level			
Low level of maternal education		0.49 (0.90)	0.47 (0.90)
No Dutch spoken at home		-1.25 (1.03)	-1.60 (1.06)
Intergenerational closure			-1.49 (1.30)
Linear time slope * Intergenerational closure			-0.27 (0.66)
Quadratic time slope * Intergenerational closure			0.18 (0.26)
No. of Parameters	10	21	21
AIC	3296.70	3272.28	3260.56
Schwarz's BIC	3331.88	3307.39	3295.67

Note: wave 3 = time 0; + indicates $p < .10$, * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$; restricted maximum likelihood estimation; 10 imputed datasets.

Table 4. Multilevel longitudinal models: estimates with standard errors in parentheses.

	<i>Model 4: All social capital related variables</i>	<i>Model 5: + More time interactions</i>	<i>Model 6: + Low monthly family income</i>
Intercept	5.99 (0.29)***	5.98 (0.30)***	5.99 (0.31)***
Linear Time Slope	0.66 (0.21)**	0.81 (0.24)**	0.77 (0.26)**
Quadratic Time Slope	-0.55 (0.09)***	-0.63 (0.11)***	-0.60 (0.12)***
Variance components			
Classroom Random Intercept Variance $\tau_{V_{00}}^2$	0.81 (0.29)**	0.82 (0.30)**	0.82 (0.30)**
Classroom Intercept-Linear Covariance $\tau_{V_{00,10}}$	-0.18 (0.08)*	-0.19 (0.08)*	-0.19 (0.08)*
Classroom Random Linear Slope Variance $\tau_{V_{10}}^2$	0.08 (0.03)**	0.08 (0.03)**	0.08 (0.03)**
Student Random Intercept Variance $\tau_{U_{00}}^2$	1.68 (0.15)***	1.68 (0.15)***	1.69 (0.15)***
Student Intercept-Linear Covariance $\tau_{U_{00,10}}$	-0.10 (0.04)*	-0.10 (0.04)*	-0.10 (0.04)*
Student Random Linear Slope Variance $\tau_{U_{10}}^2$	0.09 (0.03)***	0.09 (0.03)***	0.09 (0.03)***
Residual Variance σ_e^2	0.33 (0.03)***	0.33 (0.02)***	0.33 (0.03)***
% total explained variance	15.21%	15.29%	15.52%
Background characteristics			
Male	0.67 (0.14)***	0.67 (0.15)***	0.67 (0.15)***
Low level of maternal education	-0.42 (0.17)*	-0.37 (0.17)*	-0.37 (0.17)*
No Dutch spoken at home	-0.36 (0.18)+	-0.43 (0.20)*	-0.43 (0.20)*
Low monthly family income			-0.01 (0.19)
Linear time slope * Male		0.16 (0.16)	0.16 (0.16)
Quadratic time slope * Male		-0.10 (0.07)	-0.10 (0.07)
Linear time slope * Low SES		-0.34 (0.18)+	-0.34 (0.18)+
Quadratic time slope * Low SES		0.18 (0.08)*	0.18 (0.08)*
Linear time slope * No Dutch spoken at home		-0.15 (0.20)	-0.15 (0.20)
Quadratic time slope * No Dutch spoken at home		0.13 (0.10)	0.13 (0.10)
Linear time slope * Low monthly family income			0.06 (0.18)
Quadratic time slope * Low monthly family income			-0.05 (0.09)
Social capital characteristics			
Single parent family	-0.29 (0.25)	-0.29 (0.25)	-0.28 (0.25)
Number of brothers/sisters	-0.08 (0.07)	-0.08 (0.07)	-0.08 (0.07)
Linear time slope * Single parent family	-0.59 (0.25)*	-0.59 (0.25)*	-0.60 (0.26)*
Quadratic time slope * Single parent family	0.32 (0.13)*	0.31 (0.12)*	0.32 (0.12)*
Linear time slope * Sibship size	-0.05 (0.07)	-0.03 (0.07)	-0.03 (0.07)
Quadratic time slope * Sibship size	0.03 (0.03)	0.02 (0.03)	0.02 (0.03)
Intergenerational closure (student level)	0.38 (0.17)*	0.38 (0.17)*	0.38 (0.17)*
Linear time slope * Intergenerational closure	0.15 (0.18)	0.15 (0.18)	0.16 (0.18)
Quadratic time slope * Intergenerational closure	-0.05 (0.08)	-0.05 (0.08)	-0.05 (0.08)
Classroom level			
Low level of maternal education	0.46 (0.90)	0.44 (0.90)	0.41 (0.90)
No Dutch spoken at home	-1.53 (1.06)	-1.64 (1.07)	-1.66 (1.06)
Intergenerational closure	-1.55 (1.30)	-1.58 (1.31)	-1.59 (1.30)
Linear time slope * Intergenerational closure	-0.39 (0.66)	-0.42 (0.66)	-0.42 (0.66)
Quadratic time slope * Intergenerational closure	0.24 (0.26)	0.27 (0.26)	0.27 (0.26)
No. of Parameters	27	33	36
AIC	3268.62	3276.78	3283.34
Schwarz's BIC	3303.69	3311.82	3318.36

Note: wave 3 = time 0; + indicates $p < .10$, * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$; restricted maximum likelihood estimation; 10 imputed datasets.

Level 2 student

$$\text{Intercept} : \beta_{0ij} = \delta_{00j} + \delta_{01j} \text{Variable}_{1ij} + \dots + \delta_{0nj} \text{Variable}_{nij} + U_{0ij}$$

$$\text{Linear time} : \beta_{1ij} = \delta_{10j} + \delta_{11j} \text{Variable}_{1ij} + \dots + \delta_{1nj} \text{Variable}_{nij} + U_{1ij}$$

$$\text{Quadratic time} : \beta_{2ij} = \delta_{20j} + \delta_{21j} \text{Variable}_{1ij} + \dots + \delta_{2nj} \text{Variable}_{nij}$$



Table 5. Multilevel longitudinal models: estimates with standard errors in parentheses.

	Model 7: + Employment situation	Model 8: + Social exclusion	Model 9: + School involvement	Model 10: + Educational expectations
Intercept	6.14 (0.33)***	5.89 (0.33)***	5.72 (0.34)***	5.65 (0.32)***
Linear Time Slope	1.02 (0.30)***	1.13 (0.28)***	0.76 (0.29)**	0.71 (0.28)*
Quadratic Time Slope	-0.73 (0.14)***	-0.79 (0.13)***	-0.59 (0.14)***	-0.58 (0.13)***
Variance components				
Classroom Random Intercept Variance τ_{i00}^2	0.82 (0.30)**	0.83 (0.30)**	0.84 (0.30)**	0.77 (0.29)**
Classroom Intercept-Linear Covariance $\tau_{i00,10}$	-0.19 (0.08)**	-0.19 (0.08)**	-0.19 (0.08)**	-0.19 (0.08)**
Classroom Random Linear Slope Variance τ_{i10}^2	0.08 (0.03)**	0.08 (0.03)**	0.08 (0.03)**	0.08 (0.03)**
Student Random Intercept Variance τ_{i00}^2	1.67 (0.15)***	1.69 (0.15)***	1.67 (0.15)***	1.62 (0.15)***
Student Intercept-Linear Covariance $\tau_{i00,10}$	-0.10 (0.04)**	-0.10 (0.04)**	-0.10 (0.04)**	-0.10 (0.04)**
Student Random Linear Slope Variance τ_{i10}^2	0.09 (0.02)**	0.10 (0.03)**	0.09 (0.03)**	0.09 (0.03)**
Residual Variance σ_e^2	0.33 (0.03)***	0.32 (0.03)***	0.33 (0.03)***	0.33 (0.03)***
% total explained variance	16.08%	15.29%	15.60%	18.92%
Background characteristics				
Male	0.68 (0.15)***	0.67 (0.15)***	0.67 (0.15)***	0.67 (0.15)***
Low level of maternal education	-0.40 (0.18)**	-0.38 (0.17)**	-0.38 (0.17)**	-0.35 (0.17)**
No Dutch spoken at home	-0.43 (0.20)*	-0.43 (0.20)*	-0.42 (0.20)*	-0.42 (0.20)*
Parental employment situation	-0.18 (0.15)			
Social exclusion index		0.04 (0.05)		
Parental school involvement			0.13 (0.09)	
Parental educational expectations				0.57 (0.21)**
Linear time slope * Male	0.17 (0.16)	0.16 (0.16)	0.16 (0.16)	0.17 (0.16)
Quadratic time slope * Male	-0.10 (0.07)	-0.10 (0.07)	-0.10 (0.07)	-0.10 (0.07)
Linear time slope * Low SES	-0.38 (0.18)**	-0.34 (0.17)+	-0.35 (0.18)+	-0.34 (0.17)+
Quadratic time slope * Low SES	0.20 (0.09)	0.18 (0.08)*	0.18 (0.08)*	0.18 (0.08)*
Linear time slope * No Dutch spoken at home	-0.14 (0.20)	-0.16 (0.20)	-0.14 (0.20)	-0.15 (0.20)
Quadratic time slope * No Dutch spoken at home	0.13 (0.10)	0.13 (0.09)	0.13 (0.10)	0.13 (0.10)
Linear time slope * employment situation	-0.25 (0.17)			
Quadratic time slope * employment situation	0.11 (0.08)			
Linear time slope * social exclusion index		-0.13 (0.06)*		
Quadratic time slope * social exclusion index		0.06 (0.03)*		
Linear time slope * parental school involvement			0.02 (0.08)	
Quadratic time slope * parental school involvement			-0.02 (0.04)	
Linear time slope * parental educational expectations				0.19 (0.21)
Quadratic time slope * parental educational expectations				-0.09 (0.10)
Social capital characteristics				
Single parent family	-0.30 (0.25)	-0.29 (0.25)	-0.27 (0.25)	-0.27 (0.25)
Number of brothers/sisters	-0.09 (0.07)	-0.08 (0.07)	-0.09 (0.07)	-0.11 (0.07)
Linear time slope * Single parent family	-0.61 (0.26)*	-0.57 (0.25)*	-0.58 (0.25)*	-0.58 (0.26)*
Quadratic time slope * Single parent family	0.32 (0.13)*	0.31 (0.13)*	0.31 (0.12)*	0.31 (0.13)*



Linear time slope * Sibship size	-0.04 (0.07)	-0.04 (0.07)	-0.04 (0.07)	-0.04 (0.07)
Quadratic time slope * Sibship size	0.02 (0.03)	0.02 (0.03)	0.02 (0.03)	0.02 (0.03)
Intergenerational closure (student level)	0.37 (0.17)*	0.37 (0.17)*	0.37 (0.17)*	0.37 (0.16)*
Linear time slope * Intergenerational closure	0.15 (0.18)	0.15 (0.18)	0.17 (0.18)	0.15 (0.18)
Quadratic time slope * Intergenerational closure	-0.05 (0.08)	-0.05 (0.08)	-0.06 (0.08)	-0.05 (0.08)
Classroom level				
Low level of maternal education	0.36 (0.90)	0.37 (0.92)	0.44 (0.91)	0.35 (0.89)
No Dutch spoken at home	-1.65 (1.09)	-1.59 (1.08)	-1.65 (1.07)	-1.86 (1.03)+
Intergenerational closure	-1.60 (1.31)	-1.59 (1.31)	-1.52 (1.31)	-1.50 (1.27)
Linear time slope * Intergenerational closure	-0.38 (0.66)	-0.42 (0.66)	-0.63 (0.66)	-0.36 (0.66)
Quadratic time slope * Intergenerational closure	0.25 (0.26)	0.27 (0.26)	0.37 (0.26)	0.24 (0.26)
No. of Parameters	36	36	36	36
AIC	3278.33	3286.42	3286.15	3267.33
Schwarz's BIC	3313.34	3321.44	3321.17	3302.34

Note: wave 3 = time 0; + indicates $p < .10$, * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$; restricted maximum likelihood estimation; 10 imputed datasets.

Level 3 classroom

$$\delta_{00j} = \gamma_{000} + \gamma_{001} \text{Variable}1_j + \dots + \gamma_{00n} \text{Variable} n_j + V_{00j}$$

$$\delta_{10j} = \gamma_{100} + \gamma_{101} \text{Variable}1_j + \dots + \gamma_{10n} \text{Variable} n_j + V_{10j}$$

$$\delta_{20j} = \gamma_{200} + \gamma_{201} \text{Variable}1_j + \dots + \gamma_{20n} \text{Variable} n_j$$

In a random student and classroom – before taking into account time effects (i.e. an empty means, three level model) – the model parameters indicate that there is a total variation across levels of 2.89. The between-student and between-classroom random intercept variances are respectively 1.64 and 0.51. There is a residual variance of 0.74. 74% of the variation (before taking into account any effects of time) therefore exists across classrooms and students or the correlation of the mathematics achievement in the three waves of the same student and classroom is 0.74 and 24% of this 74% is across classrooms $(\frac{\tau_{V_{00}}^2 + \tau_{U_{00}}^2}{\tau_{V_{00}}^2 + \tau_{U_{00}}^2 + \sigma_e^2} (\frac{0.51 + 1.64}{0.74 + 1.64 + 0.51}))$ and $(\frac{\tau_{V_{00}}^2}{\tau_{V_{00}}^2 + \tau_{U_{00}}^2} (\frac{0.51}{0.51 + 1.64}))$.³

In order to test the hypotheses (see the next section), five models were constructed and reported in Table 3 and 4: 1) a model with only the time variables (linear and quadratic time effect), 2) a model with family social capital variables (controlling for socioeconomic status, gender, language at home, low socioeconomic status and language composition variables), 3) a model with social capital at school variables (controlling for the same background variables), 4) a model with all social capital related variables (controlling for the same background variables) and 5) a model that includes time interactions with the other background variables (gender, language at home and socioeconomic status). In Table 5, we test for the robustness of our findings by including variables that are theoretically related to family and school social capital: monthly family income, social exclusion at school, employment situation of parents, parental educational expectations and parental school involvement.

4. Results

In model 1, we report a baseline model with only the linear and quadratic time effects with wave three as time zero. In model 2, we test hypothesis one and two (controlling for gender and maternal educational level and language at home at the student and classroom level).

We test whether the number of siblings in a family and living in a single parent family are negatively related with children's academic achievement. We use interaction terms between the time linear and quadratic parameters and the social capital variables to model effects on achievement. We see that children in a single parent family are predicted to have lower mathematics achievement than children in a non-single parent family. The difference in achievement is the largest and most significant in wave one and two (the interaction terms). In model 2, we see that the effects of sibship size are not significant (p-values > .10). We also analyzed with fixed classrooms effects instead of random classrooms effects because it might be argued that 24 classrooms are not many cluster units in a multilevel model. The found effects are robust to controlling for fixed classrooms effects (23 dummy classrooms) instead of random classrooms effects.

In model 3, we investigate hypothesis three and four. We hypothesized that intergenerational closure of children at respectively the student and classroom level is positively and negatively related with academic achievement. As in previous models, we included interaction terms between intergenerational closure and time. We therefore control for a moderation by time of the effect of intergenerational closure on mathematics. When children have an extensive network (they know parents of children in and outside the classroom), they are significantly predicted to have 0.38 higher mathematics scores in wave three (main effect). This effect is robust to controlling for fixed classroom effects (23 dummy

³We also tested alternative covariance structures (first-order autoregressive and Toeplitz structures) with a model that includes only a random linear time effect and a fixed quadratic time effect. We did not find any significant improvement, so we stuck to the unstructured covariance structures.

classrooms) instead of random classroom effects. Model 3 also shows that intergenerational closure at the classroom level is not significantly related to mathematics achievement. In model 4 of Table 4, we included all variables (background and social capital variables) and see that the effects of social capital remain. In model 5, we also included interactions between the linear and quadratic time effects and socioeconomic status, gender and language at home. The effects of social capital also remain. On the basis of this last model, the predicted values of the main and interaction effects of the single parent effects are plotted in Figure 2. We also plotted the predicted values of the main and interactions effects of the low socioeconomic status, networks and single parent effects.

We also report the proportions of total explained variance with the squared Pearson correlation between the predicted scores based on the fixed effects and the observed outcome (as in Hoffman, 2015). In model 2 (background variables + social capital in the family) and 3 (background variables + social capital at school), respectively 13.10% and 14.36% of the mathematics variance is explained. In model 4 and 5, we explain 15.21% and 15.29% of the mathematics variance.

In Table 5, we see that the effects of social capital of the previous models are robust. The inclusion of variables such as monthly family income, social exclusion at school, employment situation of parents, parental educational expectations and parental school involvement did not profoundly change the effects of social capital.

5. Discussion and conclusion

In this article, we investigated whether social capital is positively related to the academic achievement of children in Flemish segregated primary schools. We did this in order to identify variables that improve educational outcomes of pupils attending this type of school environment. An important spokesperson of social capital theory, Coleman, formulated why social capital in the family and outside the family is important to improve academic achievement, even when other forms of capital (e.g. financial) are not present. We assessed this theory with the use of longitudinal data that were collected in schools that are socioeconomically and ethnically segregated. We included social capital related variables and other variables that could account for the variability in the mathematics achievement in schools with predominantly immigrant and socioeconomically disadvantaged pupils. We found that social capital in the family and at school explain a small part of the mathematics achievement of fourth and fifth grade pupils in segregated Flemish primary schools.

We formulated four hypotheses: 1) The number of siblings in a family is negatively related with children’s academic achievement. 2) Children who live in a single parent family are more likely to have

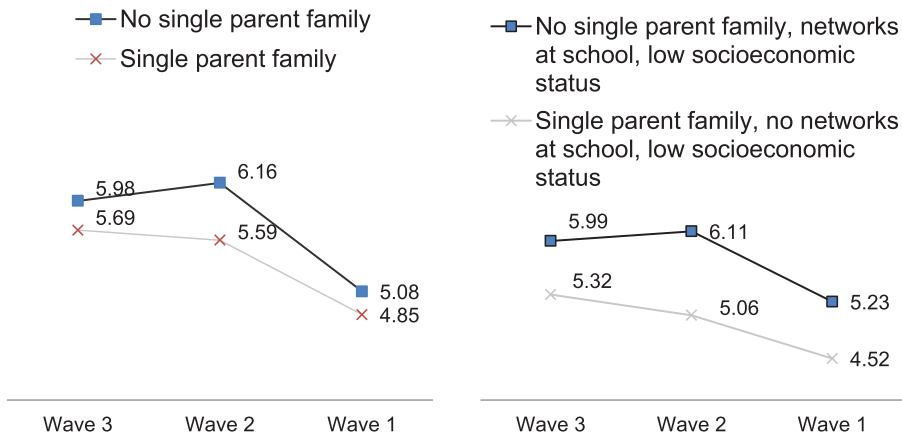


Figure 2. Predicted mathematics achievement in the fourth and fifth grade, Note: the left figure is based on model 5, table 4: $5.98+0.81(Time_{ij})-0.63(Time_{ij}^2)-0.29(SingleParent_{ij})-0.59(SingleParent_{ij}*Time_{ij})+0.31(SingleParent_{ij}*Time_{ij}^2)$. The right figure is also based on model 5, table 4: $5.98+0.81(Time_{ij})-0.63(Time_{ij}^2)-0.29(SingleParent_{ij})-0.59(SingleParent_{ij}*Time_{ij})+0.31(SingleParent_{ij}*Time_{ij}^2)-0.37(LowSES_{ij})-0.34(LowSES_{ij}*Time_{ij})+0.18(LowSES_{ij}*Time_{ij}^2)+0.38(Networks_{ij})+0.15(Networks_{ij}*Time_{ij})-0.05(Networks_{ij}*Time_{ij}^2)$.

lower academic achievement than children who live in another family structure. 3) Intergenerational closure of children is positively related with children's academic achievement. 4) Intergenerational closure of children at the school level is negatively related with children's academic achievement.

Firstly, with regards to family structure, we found insignificant effects of sibship size and negative significant effects of living in a single parent family on mathematics in the fourth and fifth grades. We therefore reject hypothesis 1 and support hypothesis 2. This is in contrast with other research that found effects for sibship size (e.g. Kreidl & Hubatkova, 2014) but is in line with other studies that found few significant effects (e.g. Wu & Tian, 2008). The reason for this might be related to the need to include other related characteristics such as the age difference between older and younger siblings because one of the mechanisms through which the effect of sibship size has been found to work is through role model effects (McHale, Updegraff, & Whiteman, 2012).

The negative effect of living in a single parent family on academic achievement is in line with previous studies which have found it to be related to a decrease in the well-being of children (see for a meta-analysis in the U.S.: Amato, 2001). We argue that the effect of living in a single parent family might be more detrimental for disadvantaged pupils with an immigrant background because of social capital related elements. Social capital seems to operate differently in immigrant communities than in native communities (Kao, 2004; McNeal, 1999). For example, the networks in (long-standing) immigrant communities in Belgium (e.g., Turkish) tend to be extended and dense and offer information, support, expectations and norms (see also Van Kerckem, Van de Putte, & Stevens, 2013). However, a family with a single parent might be detrimental for the prospects of being included in networks outside the family, when this is – for example – perceived as a stigma or running against family-related values (see also Zhou & Bankston, 1994) and expected gender roles (Van Kerckem, Van de Putte, & Stevens, 2013) that might be predominant in the migrant community to which the student belongs. It might prevent single parent families to benefit from the role that a strong community could potentially serve in providing additional knowledge and/or support (Coleman, 1990). The negative effects of parent-related characteristics on mathematics achievement can therefore be more pronounced for immigrant students. This is an avenue for further research.

We also found that knowing more parents at school has a positive effect on mathematics achievement (hypothesis 3). This is indicative of broader networks that surround the class and supports other research (e.g. Carbonaro, 1998). This is a relevant finding since it shows that the argument of Coleman is present even in – what is often defined as – a disadvantaged school composition. It also suggests the need to include additional variables to explain the lower educational achievement of disadvantaged pupils. In previous studies, low educational achievement in segregated schools was explained through peer influence (Caldas & Bankston, 1997; Mayer & Jencks, 1989). Peers in a disadvantaged school composition tend to have lower academic achievement partly because of their low socioeconomic status (OECD, 2015). Within this context, peers can have a detrimental influence, especially on high-achieving students. In this article however we challenge this interpretation and give additional support to the hypothesis that contact with children at school and knowing parents of children at school (i.e., having an extended network within the school) is an additional source of resources and support for students that can lead to higher mathematics achievement. For underprivileged pupils, peer contact might be important to have additional support and/or role models. Studies have found that the role models for Turkish or Northern-African second-generation pupils in Flanders are mainly grounded in the network of contacts they have within their own ethnic community in the hosting country. These networks were identified to be important not only for study motivation but also to promote higher educational aspirations (Van Praag, Stevens, & Van Houtte, 2015). However, until now it was not studied whether this positive effect of the immigrant community translates into academic achievement in Flemish segregated schools. This finding is a contribution of this article to the research on segregated educational contexts.

We did not find a significant negative effect of intergenerational closure at the school level and thus reject hypothesis 4. We also saw that the main effects of the socioeconomic background of the student in the different models were countered with the presence of intergenerational closure

at the student level. This is a direct support of the idea of Coleman and Hoffer (1987) and Coleman (1988).

This paper has limitations. As we already noted, the sample of our study mostly comprised pupils with an immigrant background who were born in Belgium. The results of this article should be read with this in mind. The findings presented in this paper can be further expanded by collecting a sample of immigrant pupils with more attention to the time that the pupils and their families have already lived in Belgium. This would entail an intergenerational study of immigrant pupils that could potentially identify differences in educational outcomes. Past research has shown that this is a promising area that accounted for variability in immigrant pupils' academic achievement in the American context (Guttmannova, 2016). Further studies should analyze whether the positive effect of social capital on mathematics achievement that we identified in this article is present in other cognitive areas, such as language (Larwin, 2010). The longitudinal analysis in this article can also be expanded by examining whether the effect of intergenerational closure stays or diminishes throughout students' further educational trajectories. Readers should bear in mind that we have shown new evidence for a positive *relationship* between social capital and mathematics achievement. To truly produce evidence for a causal effect of social capital on mathematics achievement, an experimental study should be devised that focuses on increasing the social capital of children. The results of such study can then be compared with a control group that does not receive an experimental treatment.

The difference between those with less social capital in the family as we defined it – namely, living in a single parent family – and those with more social capital in the family and outside the family can be interesting for devising and implementing public and school policy. Although the government or the school does not have much influence on the family structure of children, they can, however, try to take the detrimental effects of family structure into account. They can do this by constructing supportive programs that might compensate for lower social capital in single parent families. Research has concluded that the academic achievement of disadvantaged pupils is at risk when they are not attending school (i.e., during the summer period) (Slates, Alexander, Entwisle, & Olson, 2012). If pupils live in a single parent family, this becomes more problematic because single parents might not have the time or knowledge to support them at home. The schools can therefore design programs during summer that provide tutoring in key areas such as mathematics and/or language. However, these measures remain mostly reactive. Schools should also promote pre-primary learning programs because early supportive educational programs have been found to improve the academic performance of these pupils at later stages of their educational career (see also OECD, 2015). It is also possible that the school can encourage certain parental practices in single parent families that research has found to be beneficial for science achievement such as parent-child discussions about school-related issues (McNeal, 1999). With regards to public policy, the resource dilution logic behind the effect of single parental families might be counteracted by promoting governmental measures that benefit families and children, such as larger public expenditure directed to the family, including childcare benefits or reduction of taxes for families with children (see Park, 2008). Local governments can invest and make more accessible educational resources to these single parent families by organizing activities that stimulate the learning process of disadvantaged pupils. This is particularly crucial during the summer period when there is a shortage of educational activities in Flanders. However, the design of supportive programs is not enough to improve the educational performance of these pupils. It is crucial that the school and the government consider that parent awareness about the availability and the potential benefits of these programs is important. The accessibility of these programs (i.e., their timing and location) comes to mind.

The school can promote intergenerational closure by regularly organizing meetings that involve both the student and the parent(s) in dealing with problems at school and which can also provide a platform for parents to interact and exchange ideas about parenting and education related issues. Moreover, the organization of activities driven by community needs where pupils, parents and school officials, collaborate can positively contribute to academic achievement. Flemish schools can benefit from some successful experiences in the U.S., such as the Baltimore School-Family-Community Partnership program (Sanders, 1996). Peer contact can also be increased by doing extracurricular activities.

This is a potential area for school policy because pupils in schools with a relatively low social class composition, tend to lag behind in the participation in extracurricular activities (Okamoto, Herda, & Hartzog, 2013). A comprehensive policy on extracurricular activities can be beneficial to create regular contacts between pupils of different classrooms, grades and ethnic origins. Overall, these school sponsored measures could serve two complementary purposes that contribute to the social capital of disadvantaged pupils: widening and strengthening the networks available to children and parents at school and deepening their sense of belonging to the school and the wider community.

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