**Opening the Black-Box of School Segregation:**

**Mediating and Moderating Effects on Reading and Science Achievement**

## 1. Objectives

The main objective of this paper is to investigate the consequences of school segregation in the primary education in Flanders, Belgium. There are three sub-objectives:

1- *General analysis:* First, we will examine whether schools' socioeconomic status (SES) composition and national origin composition have an impact on pupils' reading and science achievement.

2- *Moderation analysis:* Secondly, we will investigate whether school segregation has a different effect on distinct SES and national origin groups.

3- *Mediation analysis:* Thirdly, we will study whether the impact of school composition can be explained empirically by teacher and student expectations and beliefs.

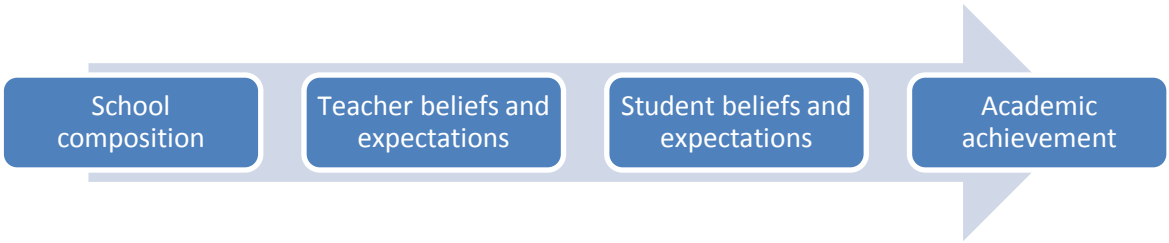
## 2. Theoretical framework and scholarly importance

Ever since James Coleman and his team (1966) published their classic study, the impact of school compositional features on pupils' academic achievement has been extensively studied. Most of these studies have been conducted in the United States (e.g., Bankston & Caldas, 1996, 1998; Rumberger & Palardy, 2005; Ryabov & Van Hook, 2007), while European sociologists are gradually more focusing on this issue as well (for France: Boado, 2007; Felouzis, 2003; for the Netherlands: Driessen, 2002; for Belgium: Dumay & Dupriez, 2008; Agirdag, Van Avermaet & Van Houtte, 2013; for Norway: Fekjaer & Birkelund, 2007). With the exception of two studies (i.e. Rumberger & Palardy, 2005; Agirdag et al., 2013), previous studies focused on *what* the consequences of school composition are, rather than on the questions (1) how these effects might be explained empirically, (2) or whether school composition affects pupils from different social-class and ethnic background differently. These highly neglected research foci require respectively mediation and moderation analyses, which are the core focus of the present study.

The great majority of previous studies have demonstrated that school *SES* composition is related to pupils' academic performance. That is, pupils who attend schools with a higher SES profile were found to have higher academic achievements. There is less consensus with respect to the impact of school ethnic or national origin composition. Whereas some authors have suggested that a higher concentration of ethnic minority and immigrant pupils is related to lower academic performance (e.g., Driessen, 2002; Dumay & Dupriez, 2008), others have not found a significant

relationship, particularly when individual SES, ethnic background, and previous academic achievement are taken into account (e.g., Fekjaer & Birkelund, 2007; van der Slik, Driessen, & De Bot, 2006).

Existing research on the impact of compositional school characteristics is strongly focused on effects on pupils' achievement. However, more recently, sociologists of education from the *CuDOS School* have theorized and demonstrated that school composition is also related to teachers' beliefs and expectations (see Van Houtte, 2002, 2011; Van Maele, 2011) and students' non-cognitive outcomes as well (Demanet, 2013; Agirdag, Demanet, Van Houtte and Van Avermaet, 2012; Agirdag, Van Houtte, and Avermaet, 2011, 2012). Agirdag, and colleagues (2013) have integrated these perspectives with the theory of self-fulfilling prophecies (Rosenthal & Jacobson, 1968). The theory of self-fulfilling prophecies states that *individual-level* pupil characteristics might trigger *individual* teacher expectations about students' abilities, which might have an impact on students' self-image, which ultimately have an influence on pupils' academic performance (Jussim, 1986). However, Agirdag and colleagues (2013) theorized that *school-level* compositional features might also trigger teacher expectations and beliefs, which in turn might reinforce student beliefs and expectations, which ultimately might have an impact on academic achievement. This theoretical rationale is depicted in the figure below.




Agirdag and colleagues (2013) demonstrated that in segregated schools teachers' had lower expectations about the 'teachability' of their students (lower teachability culture), which triggered *futility beliefs* among students in segregated schools (i.e. expectations that 'pupils like them' have no control over their academic future, both as individual students and the student-group, i.e. futility culture). They illustrated that school composition effects on math achievement were mediated by teachers' teachability culture, students' futility beliefs and futility culture. Similarly, Rumberger and Palardy (2005) found that teacher expectations explained (mediated) the effects of school SES composition on math, reading and history achievement, but not on science achievement.

In the present paper, we use the theoretical framework provided by Agirdag and colleagues (2013) and we will attempt to replicate their empirical study, using a complete different dataset. However, our aim is also to contribute to the extant literature with new insights. First, while many

authors mention the relevance of school segregation with respect to existing achievement gaps, only very few have *empirically* examined whether the effects of individual pupils' socioeconomic and/or ethnic background are moderated by school composition, that is, whether the effect of individual SES or ethnicity/national origin are different in segregated schools. Secondly, while many previous studies focused on reading or math achievement, there are only very few studies that focused on science achievement. Rumberger and Palardy (2005) did examine the effects on science achievement and they found that school SES composition had a larger impact on science than on any other outcome (reading, math and history). The Agirdag et al. (2013) study did not examine science achievement. In this study, we will examine the impact of school segregation on science and reading achievement.

## 3. Data, methods and variables

### *3.1 Data*

We use survey data gathered as part of the Validiv project. The data were collected during the academic year 2011–2012 from 67 primary schools in Flanders, Belgium. Multistage sampling was conducted. In the first instance, to encompass the entire range of national origin composition, we selected three regions in Flanders that had relatively ethnically diverse populations, i.e. Brussels, Ghent and Limburg. Second, using data gathered from the Flemish Educational Department, we chose 212 primary schools within these selected cities and asked them to participate; 32% of them agreed to. Because the non-response was not related to any school characteristics (school size, language composition, socioeconomic composition, school sector), the schools in the data set represent the entire range of national origin and socioeconomic composition: from those with almost no non-native and working class pupils to some composed entirely of non-natives working-class and non-native students. In all schools that agreed to participate, our research team surveyed all the fourth-grade pupils (most of them aged 8-9) present during our visit. Additionally, all teachers in these schools were asked to fill in a questionnaire: from a sample of 1,838 pupils 1,761 completed the survey (response rate of 95.8%), and from a sample of 1,665 teachers 1,255 completed the survey (response rate of 75.4%) The models are estimated with multilevel regression analysis, using SPSS version 20.

### *3.2 Methods*

The quantitative data consisted of a clustered sample of pupils and teachers that was nested within the schools and involved data at different levels (individual and school level). Multilevel modelling was therefore most appropriate (SPSS Version 20 is used). The missing data are handled with the

Multiple Imputation procedure: five imputations were requested and pooled results are shown. First, we will examine the general effects of school composition variables. Second, we will calculate cross-level interactions between national origin composition and SES composition on the one hand, and individual national origin and individual SES on the other hand. Third, as part of the moderation analysis, we will examine whether the effects of school composition variables on achievement outcomes changes after adding mediating variables into our models (Baron & Kenny, 1986).

*3.3 Variables*

The main *exploratory variables* are SES composition and national origin composition. SES composition is measured by aggregating individual SES-scores of pupils to school-level. Individual SES is measured by the highest occupational status coded with the International Socio-Economic Index (ISEI-08); highest score of both parents is taken as the indicator. National origin composition is measured by calculating the fraction of pupils within schools from Belgian descent; maternal grandmother's country of birth is used as an indication of national origin.

There are three *mediating variable.* Teachers' teachability expectations regarding their pupils were measured by 31 items of the Teachable Pupil Survey (Kornblau, 1982) and aggregated at school-level to calculate teacher-groups' teachability culture. Pupils' futility beliefs were measured using five items from the sense of futility scale (Brookover et al., 1978) and aggregated at school-level to calculate the level of student-groups' futility culture.

To account for selection effects, we included a set of *control variables*, such as sex, national origin, individual SES, school region into the models. To account for previous achievements, we controlled for grade retention in the past.

The main *dependent variables* are reading achievement and science achievement, both measured with adjusted standardised tests.

**4. Results and conclusions**

*4.1. Objective 1*

The results of the multilevel analysis demonstrate that, all else being equal, school SES composition is significantly positively related to both reading achievement ($\beta$[1]=0.255; $p$<0.000) and science achievement ($\beta$ = 0.274; $p$<0.000). In other words, pupils going to schools with a higher SES composition are likely to perform better than pupils in low SES schools. However, the national origin

[1] $\beta$ =Standardized regression coefficient. Calculated as unstandardized coefficient multiplied by standard deviation of the explanatory variable, divided by the standard deviation of the dependent variable (Hox, 1995)

composition of the school is *not* significantly related to reading achievement (β=-0.051; *p*=0.426), neither to science achievement (β=-0.031; *p*=0.608). However, it should be noted that the distinction between SES composition and national origin composition is mostly an artificial/analytical distinction as in the reality there is a large overlap between both[2]. Yet, in analytical terms, it is the SES composition that matters, not the national origin composition.

*4.2. Objective 2*

The second objective is to study whether the effects of individual pupils' national origin and SES is moderated by school compositional features. First, we enter cross-level interactions with school SES composition; secondly we enter cross-level interactions with school national origin composition. None of the examined interaction terms with respect to reading achievement or science achievement reach the level of statistical significance. Hence, our results suggest that the effects of school segregation are *not* larger or smaller for a specific national origin group or SES. In other words, school segregation is likely to affect all groups equally. Still, segregation is relevant for educational inequality as low SES groups and those from a different national origin are the ones who are primary enrolled in these schools.

*4.3. Objective 3*

The third research objective is to investigate whether teacher-group teachability expectations (i.e. teachability culture), students' futility beliefs and student-group futility beliefs (futility culture) mediates the effects of school SES composition (see Objective 1). With respect to reading achievement, we find that teachability culture has a positive effect (β=0.155; *p*=0.005), futility beliefs have a negative influence (β=-0.164; *p*<0.000), while futility culture is not related to reading achievement (β=-0.031; *p*=0.480). Most important, after entering these variables, we find that the effect of school SES composition is reduced to an insignificant level (β=-0.092; *p*=0.154). As such, in line with the findings made by Agirdag et al. (2013), our results demonstrates that teachability culture and sense of futility explain why school SES composition is related to reading achievement.

With respect to science achievement, on the other hand, we find that teacher-group teachability culture do not have a direct significant effect (β=0.076; *p*=0.138), students' futility beliefs had a negative influence (β=-0.155; *p*<0.000), student-group futility culture is not significantly related to reading achievement (β=-0.008; *p*=0.850). While after entering these mediating variables, the effect of school SES composition was reduced in size, it is still significantly related to science

[2] There is a correlation of 0.747 between both: schools with a high SES are mostly schools with a large share of native Belgian students

achievement (β=0.191; *p*=0.007). Hence, in line with the findings made by Rumberger and Palardy (2005), the results of the present study demonstrates that mediating variables do not completely explain the effect of school SES composition on science achievement.

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