



Variation in teachers' academic optimism: Examining the impact of classroom composition and school academic optimism

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ABSTRACT

Teacher academic optimism (TAO) is crucial for student achievement, even considering background variables like SES and migration. This study investigates the variation of TAO in relation to classroom composition, educational track, and teachers' perception of school-level academic optimism (SAO). Bayesian multilevel structural equation modelling, conducted on data from 1061 teachers in 37 secondary schools, reveals that educational track significantly influences TAO, regardless of students' background characteristics. Furthermore, the relationship between SAO and TAO is emphasized. To cultivate inclusive and effective learning environments, policymakers and educators should prioritize investing in SAO, particularly in vocational tracks.

1. Introduction

The concept of teacher academic optimism is gaining importance as a framework for understanding in-school factors that influence student achievement and have the potential to mitigate adverse effects of student background characteristics, both in primary and secondary education (Hoy, 2012). It encompasses the interplay between teacher efficacy, teacher trust in students and parents, and academic emphasis, and has been shown to be a crucial determinant of a teacher's ability to optimise learning opportunities (Chang, 2011; Hoy et al., 2006; Woolfolk Hoy et al., 2008). Even after controlling for background variables such as socioeconomic status (SES) and migration background, research shows a positive correlation between teacher academic optimism and student outcomes (Ates & Unal, 2021). This underscores the significance of academically optimistic teachers. Despite the potential promise of the concept, there still is limited understanding of the factors that influence teacher academic optimism in urban secondary schools and whether teachers are equally optimistic in different classroom and school contexts.

Teacher academic optimism is rooted in the research on school academic optimism, a school-level construct that reflects the normative patterns of the perceived school culture and involves a triadic interaction among collective efficacy, faculty trust in students and parents, and school-wide academic emphasis. Prior research in Taiwanese secondary schools indicates that between-school variance in teacher academic optimism is predicted by school academic optimism (Hong, 2017). Therefore, it is important to consider academic optimism at the teacher as well as at the school level to understand its full potential to create a positive impact on the performance of all. In addition, considering that educational research demonstrates that students from specific social groups – those with lower socioeconomic status, migration backgrounds, males, or enrollment in non-theoretical educational tracks – are consistently prone to academic underperformance (Gross et al., 2016; OECD, 2019), it is crucial to understand the role of these compositional variables and students' educational track too. This is reinforced by studies that show that the composition of the student

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population correlates with school and teacher academic optimism. Research in primary schools indicates that school academic optimism varies with the socioeconomic (Boonen et al., 2014) and ethnic (Wu & Lin, 2018) composition of the school, and that teacher academic optimism is generally lower in classrooms with a higher number of low SES students (Woolfolk Hoy et al., 2008). There are reasons to assume this will be the same in secondary education. Indeed, when examining the subconcepts of academic optimism, teachers in socioeconomically disadvantaged secondary schools were found to report lower levels of collective and individual efficacy compared to teachers in more advantaged secondary schools (Goddard, LoGerfo, et al., 2004). Other research shows a negative correlation between the proportion of students in secondary schools with lower SES and/or minority backgrounds and both trust (van Maele & van Houtte, 2009) and belief in the ability of these students to meet high academic expectations (Van Maele & Van Houtte, 2011; Vervaet et al., 2016). Gender and educational track are also found to be factors of influence. Research indicates that the proportion of girls in school has a positive correlation with the level of faculty trust (Van Maele & van Houtte, 2009), and teachers teaching high-track classes tend to have higher expectations for the same student than teachers teaching low-track classes (Kelly & Carbonaro, 2012).

In summary, the literature indicates that these compositional elements and students' educational track have an impact, yet there remains a gap in knowledge about the unique contribution of each element when considered together. In addition, compositional elements are usually examined at the school level, eliminating the nuanced dynamics of the classroom. It is crucial to examine the ways in which these variables intersect and influence teachers' perceptions and expectations of student success. While it is widely recognised that the quality of teaching is the foremost school-level factor when it comes to explaining student achievement (Blömeke et al., 2016), previous examples show that not all students receive the same effective learning support. To the best of our knowledge, no prior study has comprehensively examined how teacher academic optimism relates to classroom composition variables, while considering educational track and controlling for teachers' perception of school academic optimism. To fully understand the potential of teacher academic optimism and its subconcepts to promote fair and excellent schools, a better understanding of how teacher academic optimism varies in relation to contextual variables is needed. Hence, this study aims to answer this question: To what extent do the subconcepts of teacher academic optimism vary with class composition, educational track, and teachers' perception of academic optimism at the school level?

2. Conceptual framework

This section presents a conceptual overview of the variables included in this study. We describe teacher academic optimism and provide an explanation of the concept of school academic optimism. Afterwards, we examine the characteristics of classroom composition used in this study. These include socioeconomic and migration background, gender, and educational track.

2.1. Teacher academic optimism

Teacher academic optimism is described as an individual teacher's positive attitude concerning their ability to teach, to build trusting relationships with students and parents, and to emphasise academic achievement (Woolfolk Hoy et al., 2008). It consists of three subconcepts in a reciprocal triadic interaction. Teacher efficacy (1) is about individual teachers believing in their personal ability to influence the performance of their students, including those who are less motivated or learning-oriented (Woolfolk Hoy et al., 2008) and those who face barriers related to low SES or migration background (Forsyth et al., 2011). Teacher trust in students and parents (2) represents the amount of trust that an individual teacher has in their students and the parents of those students (Van Maele & Van Houtte, 2012). It is about teachers trusting their students' openness and willingness to learn, ability to grasp concepts and honesty (Woolfolk Hoy et al., 2008). As a result, teachers feel secure in allowing themselves to be vulnerable, taking a risk as to whether the other will respond positively (Hoy, 2012). Recent research in Flemish secondary education emphasised that teacher trust in students and parents consists of two separate dimensions: trust in students on the one hand and trust in parents on the other, both in turn made up of two subconcepts, namely general trust – a reflection of the affective bond between teachers and students or teachers and parents – and trust in the learning orientation of students or trust in the learning orientation of parents (Lelieur et al., 2022). Teachers' sense of academic emphasis (3) is the extent to which individual teachers set high academic standards in their classrooms (Wu & Lin, 2018) and find ways to engage students in pursuing those standards (Beard et al., 2010). It involves emphasising academic behaviour (Wu & Lin, 2018) and extending the time students spend successfully and actively on school-related tasks, which relates positively to student learning and student performance (Woolfolk Hoy et al., 2008).

2.2. School academic optimism

School academic optimism is a characteristic of the perceived school culture and is also formed by the same three subconcepts but at the school team level. Collective efficacy (1) entails the shared perception among teachers that the team's efforts have a positive effect on their students (Goddard, Hoy, et al., 2004). It involves the faculty's shared beliefs and expectations about their ability to successfully teach all children, including those who are less motivated or have more difficulties that may impede learning (Wu, 2013). Faculty trust in students and parents (2) refers to the team's willingness to present themselves vulnerably to students and parents, having confidence that the latter will respond positively (Hoy & Tschannen-Moran, 2003). It is grounded in a shared sense of the other party's trustworthiness (Forsyth et al., 2011) and is a relatively stable, normative condition that is part of the school culture (Adams & Forsyth, 2013). In previous research, trust in students and parents was seen as one combined referent. However, more recent research from Lelieur et al. (2022) in urban secondary schools showed that making a distinction between trust in students on the one hand and

trust in parents on the other is not only a better analytical representation of reality, but also pivotal for gaining profound insights into the affective dimension of the relationship among teachers, students, and parents. Finally, collective academic emphasis (3) comprises the school-wide focus on each student's academic success (Hoy, 2012). The faculty shares a perspective on the value of education (Goddard et al., 2000). High yet achievable goals are set, based on the belief that all students can achieve learning goals (Hoy et al., 2006). The school environment is learning-centred, students and teachers strive for and respect academic success (Goddard et al., 2000). An important consideration is whether the culture of the normative reference group (i.e. students and teachers at the particular school) is academically oriented (Van Houtte, 2002).

2.3. Classroom composition and educational track

Educational research has consistently shown that certain social groups are particularly vulnerable to underperformance in school (OECD, 2018a). Having a migration or a lower socio-economic background, being male or attending a non or less theoretical educational track has repeatedly been found to be detrimental to educational attainment (Gross et al., 2016; OECD, 2019).

2.3.1. Socioeconomic and migration background

When referring to the disadvantaged backgrounds of students, the term typically includes their socioeconomic and/or migration background. Socioeconomic background refers to the combination of different types of family capital and resources that influence children's development, including factors such as parents' education level and occupational status (Gustafsson et al., 2018). Migration background refers to children who have migrated themselves and children whose (grand)parents have migrated (OECD, 2018b). Most research does not differentiate between these two groups of children, while the experiences of the so-called first-generation students, who themselves migrated, are distinct from those of second- or third-generation students. For example, first-generation students generally have the highest achievement motivation compared to native students, both immigrant (second- or third-generation) and non-immigrant (OECD, 2018b), but at the same time the lowest performance scores of all these groups (Gries et al., 2022). In addition, it can be challenging to determine which factor holds more significance – a low SES or a migration background – as children with migration backgrounds often face both circumstances simultaneously, making it difficult to isolate the impact of each on their outcomes. Findings from PISA 2018 show that across OECD countries, an average of 12% of the variance in reading skills scores can be attributed to students' SES. Advantaged students outperform disadvantaged students by 89 points, an equivalent of two years of schooling (OECD, 2019). While SES appears to be the primary factor in explaining these performance differences (Agirdag et al., 2012; OECD, 2019), having a migrant background also plays a role (Danhier & Jacobs, 2017). In most PISA-participating countries, students with a migration background score lower than those without, both before and after accounting for SES (Cerna et al., 2021). Nevertheless, two important points are to be considered: in most education systems, SES plays a more important role than migration background, and the so-called 'ethnic achievement gap' is much smaller in most systems than in Flanders (Danhier & Jacobs, 2017). This implies that other factors play a role, and this is what our study aims to focus on.

To explain these achievement gaps, several relevant mediating factors related to academic optimism have been identified. Teacher trust in students and parents appears to mediate the relationship between low SES or migration background and student achievement (Goddard et al., 2009b). Additionally, teachers' efficacy beliefs have been identified as a key determinant in addressing the impact of SES on student achievement (Parker et al., 2006). The finding that teachers are less likely to teach learning strategies in classroom contexts with a higher share of low SES or migrant students, explains how lower academic expectations could lead to lower performance outcomes (Dewulf et al., 2022). These findings, combined with other research showing that trust in students and parents (Van Maele et al., 2014), teachers' efficacy beliefs (Woolfolk Hoy et al., 2008), and teachers' academic emphasis (Van Maele & Van Houtte, 2011) are lower in schools or classes with higher shares of low SES or migrant students, emphasise the significance of considering multiple variables when addressing the different subconcepts of teacher academic optimism.

2.3.2. Gender

In addition to socioeconomic and migration background, gender also seems to have an impact. In general, girls tend to outperform boys (Belfi et al., 2012), while boys exhibit a greater sense of academic futility (Van Houtte, 2016) and are more at risk of feeling alienated from school (Hadjar & Backes, 2022). Furthermore, teachers tend to discuss more misconduct and negative character traits related to boys and appear to have more negative interactions with boys than with girls (Consuegra et al., 2016). Here too, a mediating role for teachers and their attitudes towards boys and girls can be observed. The higher the percentage of girls in school, the more likely that teachers view students as trustworthy (Van Maele & Van Houtte, 2011). Moreover, teachers with high efficacy beliefs are more likely to have gender equality beliefs (Gråstén et al., 2022). Gender and the aforementioned background variables may intersect, as boys who are born in disadvantaged families tend to have lower achievement scores and are less likely to complete high school than their female counterparts from similar backgrounds (Autor et al., 2019). Also, academic expectations appear to be lower for low SES boys (Auwarter & Aruguete, 2008).

2.3.3. Educational track

There are various methods of assigning students to classes, but the key consideration is whether to create heterogeneous or homogeneous groups (Hattie, 2002). The primary distinction is between comprehensive education systems, in which all students follow a similar educational path regardless of prior school performance, and education systems that rely on horizontal stratification by grouping students based on ability or interests (OECD, 2019). The present study considers this between-class ability grouping, also known as tracking. The main goal of the tracking system in our research context is to group students based on their skills and interests.

However, many students initially pursue academic paths but change to technical or vocational fields during their school careers when they ‘fail’ to do well in the academic track (Clycq et al., 2014). Moreover, the chance of having to repeat a year is higher in technical or vocational tracks, and a less academically orientated staff culture is found to be one of the contributing factors (Van Houtte, 2004). Especially vocational education faces certain image-related challenges, as indicated by a CEDEFOP study in 2017 which revealed that most European citizens perceive general secondary education as having a more favourable reputation compared to vocational education. Even more, in many EU member states vocational education is perceived as a final resort and a second choice for second-rate students (CEDEFOP, 2017). However, it’s essential to consider cross-cultural nuances in this perception. Several countries, such as Finland, the UK, and Italy, hold a much more positive view of vocational tracks. In contrast, Belgium, the country where this study is conducted, falls among the countries where vocational education is viewed as the least favourable educational track (Milmeister et al., 2022). Such broader, negative stigmatisation can result in demotivation among both students and teachers (Hattie, 2002). The so-called waterfall system, which involves starting in higher-appreciated tracks and gradually transitioning to the tracks considered less valuable, tends to be more prevalent among male students and those from lower SES or migration backgrounds, resulting in overrepresentation of these groups in the ‘lower’ tracks (Boone & Van Houtte, 2013; Scheeren & Bol, 2022). The above findings make us hypothesise that teachers in these so-called lower tracks are less academically optimistic, with potential implications for students who already face disadvantages.

Taking this situation into account, in the current paper we study to what extent school academic optimism, classroom composition elements related to SES, migration background and gender, and educational track correlate with teacher academic optimism.

3. Method

In this section, we describe the sample, the data collection procedure, the measures, and the statistical procedures used to answer the research questions.

3.1. Sampling and data collection

Data were collected in Antwerp, the largest city in Flanders (Belgium), with more than 500,000 inhabitants and with a (for this study) considerable variety of secondary schools in terms of ethnicity and SES. To ensure representation across different strata of schools, we employed a stratified clustered systematic sampling approach. This method involved ranking schools from highest to lowest according to the number of disadvantaged students, based on two student-level indicators used by the Flemish government to determine which schools need extra funding to increase equal educational opportunities: ‘language spoken at home’ and ‘the mother’s highest level of completed education’. The resulting list was divided into five equal groups and a proportional number of schools was systematically sampled per group. If the principals agreed to participate, they were asked to distribute the online survey link to their teachers. This kind of sampling could contain biases within the respondent group, as it introduces a non-random element based on voluntary response, allowing the self-selection of participants to influence the group composition (Biffignandi & Bethlehem, 2021). Despite this limitation, we carefully considered the options available and determined that this method was the most suitable. Schools in Flanders have the autonomy to decide whether to participate in research, so the possibility of selective dropouts cannot be entirely dismissed. However, we currently lack any apparent reasons to believe that this occurred, which is supported by our comparison with the population (see Table 1). In addition, to maintain the integrity of our analyses and ensure robust results, we set specific criteria for participation. Principals were informed that, for effective clustered analyses, a minimum of 20 participating teachers per school was necessary (or 10 in schools with fewer than 30 teachers). To enhance the generalisability of our study, we aimed to involve a minimum of 40 secondary schools out of the 90 schools in Antwerp. To accomplish this, we approached 55 schools, ultimately securing participation from 41 schools. Among these, 37 schools exceeded the school’s internal response threshold, with a response rate of 67%. A total of 1061 teachers participated in the study, accounting for approximately 18% of all secondary school teachers in Antwerp. This is an average of 29 respondents per school, with a range of between 11 and 58 respondents. An overview of the respondents’

Table 1
Descriptive statistics of respondents’ characteristics.

Respondents’ characteristics	sample	population
Gender		
Female	63.4%	64.3%
Male	36.2%	35.7%
Other	0.4%	NA
Age		
20-29 years	12.1%	14.8%
30-39 years	27.1%	28.2%
40-49 years	31.9%	28.2%
50-59 years	24.3%	22.4%
60+	4.4%	6.4%
Educational degree		
bachelor	46.1%	52.6%
master	43.3%	38.4%
other	10.4%	9%

characteristics compared to the population (secondary school teachers in Flanders (Departement Onderwijs en Vorming, 2022)) is given in Table 1.

3.2. Measures

The adapted (and validated) Survey for Academic Optimism (Lelieur et al., 2022) was used to map out teacher and school academic optimism. Teacher academic optimism was surveyed through 29 items, subdivided into four scales: teacher efficacy, teacher trust in students (consisting of general trust in students and trust in students' learning orientation), teacher trust in parents (consisting of general trust in parents and trust in parents' learning orientation), and teacher academic emphasis. All items were scored on a 7-point Likert scale, ranging from 'strongly disagree' (1) to 'strongly agree' (7). When scoring the items, teachers were asked to keep one specific class group in mind: the first class they teach in a typical school week. The items were designed to capture the personal ideas, feelings, and behaviours of the respondents themselves in the context of this class group. Table 2 contains item examples for the subconcepts and shows that the scales have a Cronbach's alpha value of at least .74.

The school academic optimism questionnaire consists of 19 items divided into four subscales: collective efficacy, faculty trust in students, faculty trust in parents and collective academic emphasis. Similar to the subscales of teacher academic optimism, the items were scored on a 7-point Likert scale. When scoring the items, respondents were asked to keep the entire team of teachers in mind. This is called a referent-shift design, which is an appropriate way to capture respondents' perceptions about their team's actions, beliefs, and attitudes (Bliese, 2000; Chan, 1998). We estimated school academic optimism using a two-level SEM model where the first-level latent variables represent the four subcomponents. Both questionnaires were validated in the context of secondary education in Flanders by Lelieur et al. (2022). We refer to this open-access article for further information on the validation processes and the relationship between observed variables and latent constructs.

We also surveyed the compositional features of the class group the respondents had in mind when answering the teacher academic optimism items. The variables included were the number of boys, low SES students, first-generation migrant students and second- or third-generation migrant students. Each of these variables was based on the teacher's own estimate of the number of students in each category present in the class group they had in mind when answering the teacher academic optimism items. The variables were calculated as a percentage based on the total number of students in that class - also reported by the teacher. Table 3 gives an overview of the minimum, maximum and mean presence of the students with these characteristics.

Finally, respondents were asked to record the educational track of the class group. For this study we made a distinction between four types of educational track: (1) the first grade, and for the second and third grade: (2) the academic finality, (3) the vocational finality, and (4) the double finality. In Flanders, the first grade of secondary school is typically a general programme designed to accommodate most students, except for a small number of students who are already being prepared for the vocational track. From second grade onwards, there are three distinct tracks, each with a specific so-called 'finality'. The academic finality is designed for students who intend to pursue higher education. The vocational finality is aimed at preparing students for immediate entry into the workforce after secondary education. Lastly, the double finality offers students the flexibility to choose between attending higher education or starting work after completing secondary education, typically in technical or artistic fields. Table 3 also shows the mean presence of the compositional features by educational track.

When employing a single survey with a single group of respondents to assess all variables, the potential for single-source or common-method bias arises. In such cases, there is a risk of bias in estimating the effect of one variable on another, due to systematic factors associated with the measurement method, rather than the underlying theoretical constructs the measurements represent (Podsakoff et al., 2012). While there are no definitive remedies for mitigating this concern (Favero & Bullock, 2015), we have made efforts to address it by offering explicit and distinct instructions. Nevertheless, as in most survey research, it is important to take into consideration this potential bias.

3.3. Statistical procedures

In this section, the Bayesian implementation of a Multilevel Structural Equation Model (Multilevel BSEM) is presented, with a particular emphasis on the details of the fitted models and the model selection procedure. Additionally, the Bayesian estimation procedure is described, explaining the software and techniques employed for parameter estimation.

Table 2
Teacher and school academic optimism – descriptives and Cronbach's alpha.

Teacher academic optimism (TAO) and subconcepts	item example	items	min	max	M	SD	α
Teacher efficacy (TE)	I can motivate those students who show low interest in schoolwork to do their best.	6	1	7	5.39	.73	.80
Teacher trust in students (TTinS)	I trust these students.	8	1	7	5.34	.90	.89
Teacher trust in parents (TTinP)	The parents of these students encourage their children to achieve good results.	10	1	7	4.68	.92	.91
Teacher academic emphasis (TAE)	I set high but attainable goals for all students in this class.	5	3	7	5.91	.66	.74
Teacher academic optimism (TAO)	/ (see subconcepts)	29	1	7	5.26	.66	.74
School academic optimism (SAO)	Teachers in this school believe that every student can learn.	19	1	7	5.05	.75	.86

Table 3

General distribution compositional variables within classrooms and by educational track.

Class composition variable	General				Mean by educational track			
	min	max	M	SD	1G	AF	VF	DF
Boys	0%	100%	53%	30%	50%	42%	57%	51%
Low SES students	4%	100%	40%	27%	27%	20%	44%	23%
First-generation migrant students	4%	100%	39%	29%	22%	19%	40%	20%
Second or third-generation migrant students	0%	100%	51%	35%	54%	43%	65%	37%

1G: first grade, AF: academic finality, VF: vocational finality, DF: double finality.

Bayesian implementation of the Multilevel Structural Equation Model Structural Equation Modelling (SEM) is a label for a broad class of statistical methods employed to estimate models that specify (causal) relationships among observed and latent variables (Kline, 2005). One of the major strengths of SEM lies in its ability to account for measurement errors by explicitly modelling latent variables and their relationships with observed variables. In doing so, the approach mitigates measurement imprecisions and obtains more precise estimates of variable relationships (Nunkoo & Ramkissoon, 2012). In this research, constructs like school academic optimism and any of the subconcepts within teacher academic optimism are treated as unobservable variables that account for the observed covariation among a collection of items assessed using the adapted Survey for Academic Optimism (Lelieur et al., 2022). Consequently, these constructs are estimated as latent variables. Additionally, given the anticipated correlations among the subconcepts of teacher academic optimism, the latent variables are estimated simultaneously considering these correlations.

Nevertheless, basic SEMs prove inadequate when the latent or observed variables are repeated measurements from the same individuals, locations, or moments in time, a scenario commonly referred to as data clustering. In such circumstances, basic SEMs can yield biased and inefficient parameter estimates, potentially diminishing statistical power or increasing the likelihood of Type I errors (Everitt & Skrondal, 2010). Consequently, when data clustering is present, Multilevel SEM emerges as a superior modelling choice. This model extends the capabilities of basic SEMs by addressing the challenge of data clustering through the incorporation of random effects. Random effects are parameters that vary at more than one level of the data hierarchy or clustering (Bryk & Raudenbush, 2002). In this study, the need for Multilevel SEM arises from the employed sampling mechanism and data collection process, specifically the stratified clustered systematic sampling.

Consequently, the implementation of the Multilevel SEM was carried out using Bayesian estimation procedures. The Bayesian approach was selected based on three key properties relevant for the present study. First, previous research has shown that Bayesian methods perform better than classical methods when dealing with highly complex and over-parameterised models (Baker, 1998; Kim & Cohen, 1999). Second, Bayesian methods are known to work well with smaller sample sizes (Baldwin & Fellingham, 2013; Depaoli, 2014; Lambert et al., 2005). Finally, Bayesian methods can incorporate prior information to restrict parameters to a permitted space, such as the estimation of positive factor variances, which can prevent issues of non-convergence or improper parameter estimation observed in classical methods (Martin & McDonald, 1975; Seaman et al., 2012).

3.4. Fitted models

Five different Multilevel SEMs were estimated. Each model estimated the measurement and structural components of the four subconcepts of teacher academic optimism simultaneously. The models varied solely in their approach to testing the research hypotheses within the structural component of the Multilevel SEM.

Firstly, an intercept-only model (model 0) was included as a general point of reference. Secondly, a model with intercept and school random effects (model 1) is estimated to establish the necessity of employing a Multilevel SEM. Subsequently, three additional models were estimated: a model featuring school random effects, intercepts, and fixed effects (model 2a), a separate model including school random effects, intercepts, fixed and school academic optimism effects (model 2b); and lastly, a model incorporating random effects,

Table 4

Proposed statistical models - Structural model parametrisations.

Model	Description	Parameters included							School academic optimism
		Intercept	Random effects	Fixed effects					
				Boys	Low SES	1st gen migrant	2nd & 3th gen migrant	Educational track	
0	Intercept Only	X							
1	Random effects only	X	X						
2a	Random and fixed effects	X	X	X	X	X	X	X	
2b	Random, fixed and SAO effects	X	X	X	X	X	X	X	X
2c	Random and SAO effects	X	X						X

intercepts, and school academic optimism, without fixed effects (model 2c). Each one of the models represents a distinct approach to investigate the research hypotheses. Table 4 provides an overview of the parametrisation for the full set of investigated models.

3.5. Estimation procedure

The models were estimated using the software R version 4.2.2 (R Core Team, 2015) to handle the data and produce the outputs for the models. Furthermore, the software STAN version 2.26.1 (Stan Development Team, 2021) was used to access the Bayesian estimation procedure. The procedure implemented in STAN was the Hamiltonian Monte Carlo (HMC), more specifically the No-U-Turn Sampler (NUTS) (Hoffman & Gelman, 2014). Four Markov chains were implemented for each parameter and distinct starting values were provided for each of the chains. Given the Bayesian estimation procedure, no burn-in or thinning was necessary, but rather a warm-up phase. Therefore, each chain was run for 4,000 iterations, where the first 2,000 iterations served as a warm-up phase and the remaining 2,000 were considered 'effective' samples. To assess the performance of the chains, in terms of achieving stationarity, convergence and good mixing, the trace, trunk and autocorrelation plots (ACF) for each model parameter were visually inspected (McElreath, 2020b). For each of the model parameters, all chains appeared to visually converge to a constant mean and variance in the post-warm-up portion of the chain, observed in the trace plot. Moreover, each chain seemed to explore the parameter space in a seemingly random way, as observed in the trunk plots and the low autocorrelation in the ACF plots. Additionally, the assessment of convergence and mixing was supported by the potential scale reduction factor (Rhat) and effective sample size (neff) statistics developed by Gelman & Rubin (1996). The maximum value allowed for the Rhat to assume convergence was 1.05, while no cut-off value was set for the neff statistics: the assessment of the 'effective sample size' of each parameter was considered enough. The Gelman and Rubin diagnostics indicated that convergence was obtained in the post-warm-up iterations for each chain, and that each parameter had sufficient sample points from the posterior. In summary, the plots and statistics indicated that the parameters achieved convergence, good mixing, and lack of serial autocorrelation (McElreath, 2020a). Finally, it is important to mention that we implemented weakly informative priors for each of the parameters in the model, and all of the points of the WAMBS checklist (Depaoli & Van de Schoot, 2017) were addressed.

3.6. Model selection

The current research used the Information-Theoretic Approach (Anderson, 2008; Chamberlin, 1965) for model selection. Furthermore, the criteria used for selecting among competing models were the widely applicable information criteria (WAIC) (Watanabe, 2013). Two reasons justified the use of these criteria. First, they use all the information contained within the posterior distribution of the parameters, effectively integrating all the uncertainty present in the parameter estimates. Second, and of greater significance, these criteria provide the best approximations for the cross-validated deviance (McElreath, 2020a). The deviance serves as the best approximation for the Kullback-Leibler divergence (Kullback & Leibler, 1951), which measures the extent to which a model accurately describes the true distribution of the data. Consequently, by comparing the WAIC across competing models, we can assess which model deviates the most from 'perfect predictive accuracy' for our data (McElreath, 2020a).

4. Results

4.1. Descriptives

Examining the descriptive results presented in Table 2, it is noteworthy that the mean value for teacher academic emphasis is high ($M=5.91$), while the standard deviation is relatively low ($SD = .66$). This suggests a high degree of consensus among teachers regarding the maintenance of high academic standards in their teaching practices. Additionally, teacher efficacy also has a rather high mean ($M = 5.39$), signifying that teachers on average believe in their personal ability to influence their students' performance, even in cases where students may lack motivation or have learning difficulties. In terms of trust, there is a notable disparity between the mean scores for teacher trust in students ($M = 5.34$) and teacher trust in parents ($M = 4.68$), with the latter scoring considerably lower. Teacher academic optimism in general ($M = 5.26$) has a higher mean than school academic optimism ($M = 5.05$). Additionally, the standard deviation for teacher academic optimism is smaller ($SD = .66$) than the standard deviation of school academic optimism ($SD = .75$), indicating that there is less variation in teacher academic optimism among respondents than in school academic optimism.

Table 5
Proposed statistical models - WAIC criteria.

Model name	WAIC	pWAIC	SE	dWAIC	dSE	weight
Model 2b	46441.08	1953.25	246.24	0	0	1
Model 2a	46460.86	1963.78	246.63	19.78	8.86	0
Model 2c	46464.7	1966.23	245.98	23.62	11.07	0
Model 1	46473.39	1971.28	246.35	32.31	13.77	0
Model 0	46490.08	1984.34	246.66	49	16.52	0

4.2. Model comparison

Table 5 reports the WAIC criteria for all the proposed models, sorted by the appropriate statistic. Two results are apparent from the tables. First, model 2b is supported by 100% of the evidence (weight). Model 2b is a model with intercepts, school random effects, fixed effects, and school academic optimism effects for each of the subscales within teacher academic optimism. A clear hierarchy of fit among the models is observed, as measured by the dWAIC, that favours model 2b. This hierarchy reveals a clear separation between the best-fitting model and the rest, when the dWAIC are compared to the precision of model fit (dSE). Second, we observe a greater over-fitting penalty (pWAIC) for models with fewer parameters (e.g. model 0). This is a striking result, as one would expect that a model with fewer parameters would over-fit the data to a lesser extent. However, in this case, the results imply that given the

Table 6
Model 2b estimation results.

	Estimate	SD	HPDI lower	HPDI upper
Teacher efficacy				
Intercept	.06	.05	-.03	.17
School academic optimism	.24	.05	.15	.34
Boys	-.01	.02	-.06	.04
Low SES	-.01	.03	-.07	.05
1st generation migrant	.01	.03	-.05	.07
2nd or 3rd generation migrant	-.02	.03	-.07	.04
Educational track (comparison)				
Academic Finality – First Grade	-.05	.09	-.23	.13
Vocational Finality – First Grade	.10	.07	-.04	.24
Double Finality – First Grade	.13	.07	-.01	.28
Vocational Finality – Academic Finality	.15	.09	-.02	.33
Double Finality – Academic Finality	.18	.09	.01	.36
Double Finality – Vocational Finality	.03	.06	-.09	.16
Teacher academic emphasis				
Intercept	.08	.05	-.02	.18
School academic optimism	.25	.05	.14	.35
Boys	.00	.02	-.04	.04
Low SES	.03	.03	-.03	.07
1st generation migrant	.00	.03	-.05	.06
2nd or 3rd generation migrant	-.01	.02	-.05	.04
Educational track (comparison)				
Academic Finality – First Grade	.03	.08	-.12	.18
Vocational Finality – First Grade	.06	.06	-.05	.19
Double Finality – First Grade	.05	.06	-.07	.18
Vocational Finality – Academic Finality	.03	.07	-.11	.17
Double Finality – Academic Finality	.02	.08	-.13	.16
Double Finality – Vocational Finality	-.01	.06	-.12	.10
Teacher trust in students				
Intercept	.07	.05	-.02	.17
School academic optimism	.42	.08	.27	.57
Boys	-.09	.03	-.14	-.03
Low SES	-.07	.04	-.13	.00
1st generation migrant	.03	.04	-.05	.09
2nd or 3rd generation migrant	-.04	.03	-.10	.02
Educational track (comparison)				
Academic Finality – First Grade	.12	.10	-.07	.33
Vocational Finality – First Grade	-.20	.08	-.36	-.05
Double Finality – First Grade	-.04	.08	-.19	.12
Vocational Finality – Academic Finality	-.32	.10	-.52	-.14
Double Finality – Academic Finality	-.16	.10	-.36	.03
Double Finality – Vocational Finality	.16	.07	.02	.30
Teacher trust in parents				
Intercept	.05	.05	-.05	.14
School academic optimism	.37	.08	.23	.53
Boys	.03	.03	-.04	.09
Low SES	-.16	.04	-.25	-.09
1st generation migrant	-.04	.04	-.13	.04
2nd or 3rd generation migrant	-.12	.04	-.20	-.05
Educational track (comparison)				
Academic Finality – First Grade	-.13	.11	-.35	.09
Vocational Finality – First Grade	-.47	.10	-.66	-.28
Double Finality – First Grade	-.19	.09	-.37	-.01
Vocational Finality – Academic Finality	-.34	.12	-.56	-.12
Double Finality – Academic Finality	-.05	.11	-.27	.17
Double Finality – Vocational Finality	.29	.09	.12	.45

Statistically significant results (with the 95% HPDI not crossing the threshold of zero) are in bold.

complexity of the data, a model with more parameters is required. Considering these results, model 2b will be used to assess the research hypotheses.

4.3. Multilevel BSEM

The analyses presented in Table 6 show that, when controlling for the additional covariates, teachers' perception of school academic optimism is the only variable significantly associated with all subconcepts of teacher academic optimism. Specifically, an increase of one standard deviation in school academic optimism is associated with a .24 standard deviation increase in teacher efficacy (95% Highest Posterior Density Interval (HPDI) = .15 – .34), a .25 increase in teacher academic emphasis (95% HPDI = .14 – .35), a .42 increase in teacher trust in students (95% HPDI = .27 – .57) and a .37 increase in teacher trust in parents (95% HPDI = .23 – .53). Furthermore, it is observed for the covariates that a change in one standard deviation in the proportion of boys is found to have a small negative association with the degree to which teachers trust their students ($b = -.09$, 95% HPDI = $-.14 - .03$), meaning that teacher trust in students falls slightly as the number of boys increases. Also, a change of one standard deviation in the percentage of students with low SES ($b = -.16$, 95% HPDI = $-.25 - .09$) and one standard deviation in the percentage of second- or third-generation migrant students ($b = -.12$, 95% HPDI = $-.20 - .05$) were found to be negatively associated with teacher trust in parents, indicating that in classrooms with more low SES students and/or more second- or third-generation migrant students, after controlling for the additional covariates, teachers tend to have less trust in the parents of these students.

As educational track is a categorical variable that characterises the specific educational paths pursued by students, the results are presented in a comparative manner to facilitate the examination of differences among the various educational tracks. The estimate provided indicates the extent to which the first-mentioned educational track in the comparison exhibits a higher (positive) or lower (negative) value of the given variable. These results show that teachers who teach the double finality express greater efficacy beliefs than teachers who teach the academic finality ($b = .18$, 95% HPDI = $.01 - .36$). Some comparative analyses have the 95% HPDI cross the threshold of zero, indicating that there is not sufficient evidence to reject the null hypothesis. However, a careful examination of the full posterior distribution shows that around 95% of the probability density is above zero, so it is possible to state with non-negligible probability that teachers teaching the double finality have higher efficacy beliefs compared to teachers teaching the first grade ($b = .13$, 95% HPDI = $-.01 - .28$), and teachers who teach the vocational finality have higher efficacy beliefs than those who teach the academic finality ($b = .15$, 95% HPDI = $-.02 - .33$). Teachers teaching the vocational finality have less trust in students than teachers teaching the first grade ($b = -.20$, 95% HPDI = $-.36 - .05$) or teachers teaching the academic finality ($b = -.32$, 95% HPDI = $-.52 - .14$). At the same time, teachers who teach the double finality express more trust in students than teachers who teach the vocational finality ($b = .16$, 95% HPDI = $.02 - .30$). Similar patterns are found for teachers' trust in parents, with teachers who teach the vocational finality expressing less trust in parents compared to those teaching the first grade ($b = -.47$, 95% HPDI = $-.66 - .28$) or the academic finality ($b = -.34$, 95% HPDI = $-.56 - .12$), and teachers who teach the double finality expressing more trust in parents compared to those teaching the vocational finality ($b = .29$, 95% HPDI = $.12 - .45$). Finally, results show that teachers teaching the double finality have less trust in the parents than teachers who teach the first grade ($b = -.19$, 95% HPDI = $-.37 - .01$).

5. Discussion

Teachers play a key role in the educational trajectory of students and are crucial to provide support and engage with students' learning needs. However, questions remain as to whether teachers feel they can support all students in all types of classrooms in the same way, or if students' socio-demographic background and track variables influence their perceptions. In this paper, we unpacked these questions by applying the concept of teacher academic optimism, which distinguishes between four subdimensions: teacher efficacy, teacher academic emphasis, and teacher trust in students and in parents. Analysing a new dataset of 1061 teachers across 37 secondary schools in Antwerp (Belgium), we studied how these subconcepts vary with classroom composition, educational track, and teachers' perception of school academic optimism.

Given the complexity of our research objective and the number of variables involved, our statistical model comparison showed that the model with intercepts, school random effects, fixed effects, and school academic optimism effects for each one of the subscales within teacher academic optimism, explains and fits the data best. Throughout the presentation of the following conclusions, therefore, we must keep in mind that statements about the effects of particular predictors of variation in teacher academic optimism are always to be interpreted as 'after controlling for all other predictors in the model'.

Firstly, and as expected, school academic optimism is a key predictor of the subconcepts of teacher academic optimism. Specifically, for each standard deviation increase in school academic optimism, each of the subconcepts also increased (statistically) significantly, and this was strongest for teacher trust in students. These findings are consistent with previous research by Wu & Lin (2018). However, the novelty of our study is that while it builds on current insights, it further uncovers additional associations between teacher academic optimism and elements of classroom composition and educational track.

A key question is to what extent the subconcepts of teacher academic optimism relate to classroom composition, and more in particular to students' SES, migration background and gender. Our fine-grained analysis proved to be necessary, as our findings reveal a different picture from previous research indicating a negative relationship between the number of boys, low SES, or migrant students and trust levels (Clycq et al., 2014; Dewulf et al., 2017; Goddard et al., 2009a; Van Maele et al., 2014). When studying the role of these composition variables and controlling for educational track and school academic optimism, we find that an increase in the number of boys in the classroom has only a minor impact on teacher trust in students. Similarly, an increase in the number of low SES students and/or second- or third-generation migrant students only results in a slight decrease in teacher trust in parents. In addition, we have no

evidence of differences in teacher academic emphasis and teacher efficacy across any of the classroom composition variables. Thus, classroom composition plays a much more modest role than expected based on earlier studies that did not take school academic optimism and educational track into account.

Notably, the most significant effect on the subconcepts of teacher academic optimism is that of educational track, (even) after controlling for school academic optimism and class composition. Again, this is mainly related to the concept of trust in students and parents. Teachers reflecting on their students in the vocational finality have remarkably less trust in their students than teachers who teach the first grade or teach in the other finalities, with the largest difference found in comparison with teachers teaching the academic finality. Additionally, vocational teachers have less trust in parents than teachers in the other tracks, with the most significant difference observed between teachers in the vocational finality and those in the first grade.

Furthermore, there is some evidence suggesting that teachers in vocational and double finality – in schools with equal levels of school academic optimism - experience higher efficacy beliefs than teachers in the academic finality. In addition, we have no evidence of differences in teacher academic emphasis across any of the classroom composition variables or by educational track. This study does not confirm the assumption that vocational teachers may emphasise learning less due to their ‘final position’ in the previously mentioned waterfall system. Hence, our findings differ from the results of Kelly & Carbonaro (2012), which state that teachers in academic finalities tend to have higher expectations than teachers in vocational finalities.

This brings us to what we believe is the main point of discussion: the critical role of educational track in understanding teacher academic optimism, and its major impact in particular on the relationship of trust among teachers and students, and teachers and parents. It is not surprising that first-grade teachers have the highest levels of trust in parents, given the more regular teacher-parent interactions at this young age of the children (Hoy & Tschannen-Moran, 1999; Scott, 2016). More noteworthy is the impact of track on teacher academic optimism once students become separated into different tracks. From second grade onwards, students navigate between three main tracks: the academic, double finality and vocational track. Typically, in the Flemish education system, this navigation implies students ‘streaming down’ from the high-status academic track to the so-called low-status vocational track. Earlier research showed that vocational tracks carry a more negative stigma, which not only results in student and teacher demotivation (Hattie, 2002) but, as this study points out, also in less teacher trust in students and in parents. While previous research attributed these negative perceptions predominantly to students’ background variables (Van Houtte et al., 2013), our study opens differing theoretical and empirical hypotheses. It is certainly true that the vocational finality comprises a disproportionately high percentage of male students with low SES and/or a migration background, yet our study suggests that the stigma related to the track itself plays a more important role than these students’ background variables. Contrary to current beliefs in academia, policy and practice, SES, migration background, and gender had minimal unique effects (i.e. school academic optimism being alike), whereas educational track emerged as a significant determinant, indicating an increasing impact of the negative stigma associated with it.

While sobering in itself, there is reason to be optimistic about promoting teacher academic optimism, as the influence of both educational track and school academic optimism are more controllable than students’ background variables. Research has shown that cultivating controllable and unstable attributions for low levels of academic optimism is essential (Lelieur et al., 2023). Perceptions can be changed, stereotypes can be altered, and academically pessimistic schools and teachers can transform into academically optimistic ones when deficit views are challenged. Moreover, our research findings suggest that investing in (the perception of) school academic optimism, particularly in the vocational finality, can be an effective strategy for promoting teacher academic optimism. Notably, our results demonstrate that school academic optimism has the strongest predictive power of all four subconcepts of teacher academic optimism. Creating a culture that includes challenging tasks, detailed feedback, and increased personal attention from teachers to students enhances individual academic emphasis (Ding & Rubie-Davies, 2019). Principals play a crucial role in promoting trustworthiness throughout the school by demonstrating vulnerability themselves and emphasising strong relationships among all members, including students and parents (Forsyth et al., 2011). Empowering teacher teams with decision-making authority in school improvement, fostering understanding of each other’s teaching practices, agreeing on effective pedagogy, setting shared goals, and encouraging reflective practices are essential for enhancing collective efficacy (Donohoo et al., 2020). It is important, though, to also acknowledge the reciprocal relationship among the subconcepts of academic optimism. Any programme or intervention aimed at improving one element of academic optimism is best designed to support the other two elements as well (Hoy, 2012).

Regardless of the merits of this study, reflection on its limitations is needed. Relying on teacher estimates to measure classroom compositional elements, for instance, introduces a potential validity risk due to teachers’ subjective and partial knowledge of their students’ SES or migration background. However, according to the Thomas theorem (*‘If men define situations as real, they are real in their consequences’* (Thomas & Thomas, 1928)), we believe that this method provides valid information for our research. We contend that teachers’ perception of their students can exert a significant influence on how they teach and interact with them, regardless of the actual situation. Therefore, despite the likelihood of imperfect estimates, they still provide crucial insights into the relevant classroom composition for this study. Another limitation of this study concerns the selection of the independent variables. While we have included those variables that the literature defines as most significant, it is possible that other crucial variables have been overlooked. For instance, the academic optimism of students is a newly researched area that may be closely related to teacher academic optimism. Neither did we account for any teacher background characteristics, such as gender, SES, ethnicity, educational degree, or teaching experience. Future research could explore these other potential inter- and intrapersonal influences on teacher academic optimism, to provide an even more comprehensive understanding of the phenomenon. In addition, from a methodological perspective, it is relevant to further examine the relationship between school and teacher academic optimism. While the two measures capture different levels of academic optimism, they share similarities. However, due to the inherent limitations of questionnaires, it is challenging to determine the extent to which responses to one aspect influence responses to the other aspect, also known as single-source bias. Conducting further research to delve into these measurement issues will enhance our understanding of the relationship between these concepts.

Investigating the unique impact of each subcomponent of school academic optimism on teacher academic optimism will offer additional valuable insights but entails methodological challenges. While consolidating the subcomponents of school academic optimism into a single measure was inevitable in our analysis, it also brings limitations in discerning the distinct effects of each component. Hence, future research is needed to explore this in greater depth.

6. Conclusion

Our results highlight the importance of considering the effects of educational track when seeking to understand variations in teacher trust in students and parents. In schools with similar levels of school academic optimism, educational track, rather than students' background characteristics, plays a determining role. Specifically, students in the vocational finality have teachers with lower levels of teacher academic optimism than students in other finalities. Previous research has highlighted the heightened risk of lower learning achievements among students in vocational tracks (Van Houtte & Demanet, 2016), but the presence of optimistic teachers has the potential to reverse this trend. Additionally, our study contributes to the existing literature by highlighting the pivotal relationship between school and teacher academic optimism. To foster inclusive and effective learning environments, policymakers and educators should prioritise investment in school academic optimism. This includes cultivating a teaching team that believes in its ability to educate all children, fostering a trusting environment that actively involves students and parents, and maintaining high expectations for all students, regardless of their background characteristics or educational track.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT in order to improve language and readability. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

CRedit authorship contribution statement

Ruud Lelieur: Conceptualization, Methodology, Validation, Visualization, Writing – original draft. **Jose Manuel Rivera Espejo:** Methodology, Validation, Formal analysis. **Jan Vanhooft:** Conceptualization, Supervision, Writing – review & editing. **Noel Clycq:** Conceptualization, Supervision, Writing – review & editing.

Declaration of competing interest

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