LANGUAGE LEARNING
A Journal of Research in Language Studies
Language Learning ISSN 0023-8333

EMPIRICAL STUDY

Does Studying Latin in Secondary Education Predict Study Achievement in Academic Higher Education?

Cathy Hauspie [a], Stijn Schelfhout,[a] Nicolas Dirix [a], Lot Fonteyne,[a] Mark Janse,[a] Arnaud Szmalec,[a,b] Alexandra Vereeck,[a] and Wouter Duyck[a,c]

[a]Ghent University [b]Université catholique de Louvain [c]NVAO, The Accreditation Organization of the Netherlands and Flanders

Abstract: Studying Latin in secondary education is still widespread in Europe and believed to result in cognitive benefits, even beyond the linguistic domain. In this study we explored the relation between such study and later academic achievement in higher education ($N = 1{,}898$). First, we demonstrated that Latin students exhibit increased levels of study achievement in higher education, particularly in study programs other

CRediT author statement – **Cathy Hauspie**: conceptualization; data curation; formal analysis; investigation; methodology; project administration; software; validation; visualization; writing – original draft preparation; writing – review & editing. **Stijn Schelfhout**: conceptualization; formal analysis; methodology; software; supervision; validation; writing – original draft preparation; writing – review & editing. **Nicolas Dirix**: conceptualization; project administration; supervision; writing – review & editing. **Lot Fonteyne**: data curation; project administration; software; writing – review & editing. **Mark Janse**: supervision; writing – review & editing. **Arnaud Szmalec**: project administration; supervision; writing – review & editing. **Alexandra Vereeck**: writing – review & editing. **Wouter Duyck**: conceptualization; funding acquisition; project administration; supervision; writing – review & editing.

A one-page Accessible Summary of this article in nontechnical language is freely available in the Supporting Information online and at https://oasis-database.org

This work was funded by Ghent University through the SIMON project, and by the Fund for Scientific Research Flanders (FWO), project number G049821N. The funding source had no direct involvement in the study design, the collection, analysis, and interpretation of the data, the writing of the report, or the decision to submit the article for publication.

Correspondence concerning this article should be addressed to Cathy Hauspie, Department of Experimental Psychology, Ghent University, Henri Dunantlaan 2, 9000 Ghent, Belgium. Email: cathy.hauspie@ugent.be

The handling editor for this manuscript was Kristopher Kyle.

DOI: 10.1111/lang.12639

than those covering science, technology, engineering, and mathematics (STEM). Second, we explored where the instruction of Latin was a significant predictor in models of academic achievement, explaining incremental variance over 21 other cognitive, attitudinal, and demographic variables. Latin instruction was included as a variable in the prediction models in 42% of the programs (mainly in the non-STEM ones), but the incremental predictive validity was substantial only in the linguistic programs. Our results highlight how the study of Latin can be a valuable predictor of academic achievement in other study fields.

Keywords Latin; classical languages; academic achievement; higher education

Introduction

Although Latin has not been commonly used as a means for spoken or written communication for several centuries now, the language is still present to a considerable extent in the European educational field. Data from the European Commission (2023) show that in two thirds of all European countries, central education authorities regulate classical language provision for upper secondary level. Moreover, the study of Latin is even compulsory for some secondary students in one third of European countries, such as Romania, Croatia, and Montenegro (European Commission, European Education and Culture Executive Agency, 2023). In Flanders specifically, Latin continues as quite a prominent option in the curriculum of secondary education, as students can choose to take Latin from their first year of secondary education onwards (Flemish Department of Education, n.d.). One might wonder why this classical language is still offered to such a large extent given that it does not offer an immediate practical use (Bracke & Bradshaw, 2020).

One of the main arguments in favor of offering Latin as a subject in schools is that studying Latin is often perceived as a challenging cognitive endeavor. Consequently, students of Latin are rated more positively on their social status, while also receiving a higher appraisal of their general and cultural education, in comparison to those who studied modern foreign languages (Gerhards et al., 2019). Indeed, Latin is considered to be a high-level study program that targets cognitively strong students (Bennett, 2021).

Despite the considerable presence of this language in education and its reputation for being academically challenging, the position of Latin in the present-day educational field has been questioned on numerous occasions (Bennett, 2021; Katz et al., 2020). Bracke and Bradshaw (2020) expounded on this contrast in the literature concerning Latin as part of modern-day education as follows:

> On the one hand, it is praised as an aspirational subject that opens doors to modern foreign languages and European history. On the other, it is attacked for being a tool of social exclusion and a difficult dead language without practical application. (p. 1)

This criticism could explain why a diminishing trend has been observed in the number of enrollments and the number of schools offering Latin (Bracke, 2015; Katz et al., 2020). Can this decline be justified, given that the assumptions about the benefits of studying Latin are still generally accepted by parents of secondary school students (Gerhards et al., 2019; Livingstone, 2013)?

Research has shown that studying Latin is believed to promote the development of learning and reasoning strategies, and to cause achievement gains in more formal (also nonlinguistic) domains, such as mathematics (Devane, 1997; Sussman, 1978). However, the existing literature on these cognitive benefits is mostly outdated and certainly not sufficient to justify the widespread practice of and belief in classical languages education. Furthermore, very little research has investigated whether the supposed benefits of studying Latin extend beyond secondary education to higher education. Previous research is difficult to generalize to the current educational field, as several reforms have been made to the structure of higher (and secondary) education (e.g., the Bologna Process, a reform aimed at harmonizing European higher education systems; European Commission, Directorate-General for Education, Youth, Sport, and Culture, 2018). Reforms like this could have affected the relation between studying Latin and academic achievement, which is why we explore this association in the context of current higher education. Thus, the present study addresses the following research question: Does studying Latin in secondary education predict study achievement in academic higher education?

Background Literature

The Linguistic Advantages of Studying Latin

Several studies demonstrate a clear link between studying Latin and various linguistic benefits. For instance, the literature reports a robust relationship between the study of Latin and accelerated achievement levels in first language skills, such as reading comprehension, vocabulary knowledge, syntactic competence, and spelling ability (Barber, 1985; Mavrogenes, 1977; Sussman, 1978; Vanheule, 2015; Wiley, 1984). Notably, advancement in vocabulary knowledge is not confined to words derived from Latin, as knowledge of words derived from other foreign languages (e.g., from Anglo-Saxon or Greek origins) was also improved (Bowker, 1975; Gilliland, 1922). These

advantages in first language skills remained present when Latin students were compared to pupils who studied a different foreign language (e.g., French, English or Spanish; Carlisle & Liberman, 1989; Fromchuck, 1984; Haag & Stern, 2000; Masciantonio, 1977). In sum, the majority of the literature seems to be in agreement about the beneficial effect of studying Latin on first language proficiency, with only slight differences in the observed effect sizes (Bracke & Bradshaw, 2020). However, as most of these studies are rather old, so is their methodology. For example, most of the previously mentioned studies do not control for the effects of individual differences (e.g., in pupil intelligence). Thus, group differences may merely reflect confounding effects of existing pupil differences unrelated to classical language education, resulting from a preselection mechanism in classical languages tracks. Indeed, even though some studies controlled for differences in cognitive abilities (Haag & Stern, 2000; Sheridan, 1976; Vanheule, 2015; Wiley, 1984), most of them did not (Barber, 1985; Fromchuck, 1984) or only vaguely addressed the matter (Carlisle & Liberman, 1989; Gilliland, 1922; Sparks et al., 1995). For instance, Carlisle and Liberman (1989) report that the intervention group and the control group were matched, as they both performed "consistently above average in general intelligence."

Research has also shown that Latin students outperform non-Latin students on foreign language aptitude (Sparks et al., 1995). Such findings support the statement that Latin appears to promote metalinguistic awareness (Bowker, 1975; Jessner et al., 2018; Mavrogenes, 1977). However, more recent—but still dated—research by Haag and Stern (2003) has demonstrated that Latin students are actually at a disadvantage when learning a new foreign language (Spanish), in comparison to those who have previously studied another modern language (French). The authors suggested that the apparent superficial similarities between Latin and Spanish may actually complicate modern language learning because of cognitive interference.

The Nonlinguistic Cognitive Implications of Studying Latin

Besides the more obvious advantages in the linguistic domain, nonlinguistic cognitive benefits of studying Latin have also been reported, such as improvements in reasoning strategies, analytical thinking, and achievement in formal domains such as mathematics (Devane, 1997; Sussman, 1978). For instance, Sheridan (1976) demonstrated that after only 5 months of studying Latin, students had an advantage of approximately a half-year's progress in related linguistic skills (e.g., reading in the first language) and in nonlinguistic domains (e.g., mathematical computation), compared to non-Latin students.

Once again, these studies often do not report whether (or how) they controlled for differences in intelligence. Although Sheridan states that the control group was matched based on academic profiles, the matching procedure is discussed in a rather vague manner. Besides that, a study by Haag and Stern (2003), who employed a well-thought-out matching procedure, has contested the claims that studying Latin elicits cognitive benefits. The researchers reported no beneficial effects of studying Latin on IQ, mathematics achievement, or deductive and inductive reasoning.

The assumed cognitive implications of studying Latin are also reflected in the academic success of its students. Research has shown that the relation between the study of a foreign language in high school and overall college academic success in the United States, measured by the cumulative college grade point average (GPA), is strongest if the foreign language is Latin (Wiley, 1984). In Flanders specifically, studies report that pupils who study classical languages in secondary education show the greatest study efficiency and highest success rate in higher education (Duyck et al., 2017; Rombaut et al., 2006).

In sum, research suggests that studying Latin may create not only linguistic, but also nonlinguistic cognitive benefits. However, there is currently a need for more up-to-date and methodologically rigorous research on the cognitive outcomes of studying Latin. The present study partially addresses this gap in the literature, by evaluating how studying Latin in secondary school is associated with study achievement in higher education.

Mechanisms Behind the Effects Associated with Studying Latin

The working mechanism behind the benefits associated with studying Latin remains a topic of discussion. Classicists typically justify the teaching of this ancient language by implicitly or explicitly referring to the theory of cognitive transfer (Haag & Stern, 2003; Sussman, 1978). This theory states that training some skills in one domain will affect skills in another domain, implying a generalization effect beyond the skills acquired in the original training domain (Harrison et al., 2013; Jaeggi et al., 2014). According to the cognitive transfer taxonomy proposed by Barnett and Ceci (2002), a distinction between various types of transfer can be made across different domains (e.g., physical, temporal, etc.). For Latin studies specifically, the assumed transfer effects primarily pertain to the knowledge domain. More specifically, near transfer involves generalization to skills closely related to the training task, such as the linguistic benefits associated with studying Latin. Assertions of Latin's potential to enhance general cognitive capabilities can be considered as claims of far transfer, as this implies improvement in skills of a different nature

(Vereeck et al., 2023). Whether cognitive functions are actually trainable, and to what extent, is, however, still heavily contested in the field of cognitive psychology. The possibility of far transfer in particular is a subject of debate, with both supporters (Buschkuehl & Jaeggi, 2010; Jaeggi et al., 2014) and sceptics (de Simoni & von Bastian, 2018; Gobet & Sala, 2023).

However, why would Latin evoke transfer effects to domains beyond language, more than any other foreign language would? Latin is often assumed to be a rather difficult language for students to master. Indeed, Latin syntax and morphology are considered to be quite complex (Pelling & Morgan, 2010; Vantassel-Baska, 1987). Because of this complexity, the teaching of Latin is mainly centered around training the pupils' understanding of the grammar, which is often associated with additional development of students' logical reasoning skills (VVKSO, 2013). This type of instruction method is at odds with the teaching of modern foreign languages, where pure analytical training is rather sparsely used. Instead, the study of modern foreign languages is more centered around communicative skills and language fluency, in order to ensure the practical use of the language afterwards (Brandl, 2007; Richards, 2006). This different instructional approach to Latin courses might promote deeper learning than modern foreign language courses do. According to Chi and VanLehn (2012), fostering deeper learning facilitates more transfer than surface learning.

Opponents assume that it is not transfer but preselectivity effects that underlie group performance differences and thus deny that the positive effects associated with studying Latin are causal and originate from the intrinsic value of learning the language. Put differently, according to the preselectivity theory, the performance benefits that Latin students show are due to the fact that they are cognitively stronger than other students prior to enrollment (Pond, 1938; Vereeck et al., 2023). Furthermore, the benefits found in higher education could be partially due to the overlap between the knowledge gained in Latin classes and what is taught in certain academic study programs. For example, in many medical disciplines, various parts of the human body are still referred to by the Latin terms and names (Lysanets & Bieliaieva, 2018). A student who already understands Latin before starting such programs has an initial advantage compared to other students who never studied Latin. Another example of such overlap can be found in law, as Latin has a strong historical connection with the origin of European legal systems (Ristikivi, 2005). These considerations show that it is important to assess any positive effects of studying Latin on academic achievement on the level of specific study programs.

The Present Study

Before exploring the reasons why Latin students could perform better in educational settings, it should first be firmly established whether and to what extent Latin students are in fact more successful in higher education. Hence, we do not aim in the present study to explore whether cognitive transfer offers a causal explanation for classical language education benefits, as only a more controlled and experimental longitudinal design would be appropriate for such a research goal. Instead, we address the lack of research on how Latin education in secondary school is associated with student performance at university. More specifically, we examine whether studying Latin in secondary school explains incremental variance in future academic achievement, above and beyond important predictors of academic achievement identified in the higher education literature. We use a very large sample of students (uniquely large for the issue under investigation), controlling for each of the cognitive, attitudinal, and demographic measures discussed in the following section. Importantly, by controlling for such a wide range of measures, we can rule out confounding effects of the included individual differences. We address the following hypothesis: The study of Latin in secondary education predicts study achievement in academic higher education incrementally to other cognitive, attitudinal, and demographic predictors.

Predictors of Academic Achievement

In order to investigate the relation between studying Latin in secondary education and later academic achievement, it is important to consider the predictors of academic achievement that have already been established in the literature, and that may be relevant for the preselectivity hypothesis. Historically, the predictors of academic achievement have been subdivided into three main categories: cognitive, attitudinal, and demographic variables (Richardson et al., 2012).

Cognitive Variables

The first category of predictors comprises the cognitive measures, which entail skills that involve our ability to comprehend, process, and work out complex ideas. These skills are used in literacy and numeracy, for example, and are typically grouped under the concept of cognitive ability (Pierre et al., 2014). Few would contest that cognitive ability is recognized as the strongest predictor of academic achievement: Its role in predicting academic success has long been established (Farsides & Woodfield, 2003). For example, a study by Roth et al. (2015) investigated the relation between intelligence (one of

the operationalizations of the concept of cognitive ability) and scholastic achievement, measured as school grades. The authors reported a population correlation of $r = .54$, a result in line with various other studies concerning the relation between cognitive ability and GPA (Frey & Detterman, 2004).

Measures of study antecedents are also included in this category, as they are valuable predictors of study achievement in higher education (Frey & Detterman, 2004; Poole et al., 2012). Such measures (e.g., high school GPA) assess former cognitive functioning and thus correlate strongly with cognitive ability or intelligence (Hodara & Lewis, 2017; Roth et al., 2015). The present study assesses the relation between Latin education and later academic achievement in a very large sample, while controlling for an extensive range of cognitive measures.

Attitudinal Variables

The second category of predictors consists of attitudinal measures, which refer to socioemotional skills that are developed and socially determined over the course of life (Pierre et al., 2014). Various attitudinal variables explain incremental variance in academic achievement, on top of what is already explained by the cognitive predictors. Motivation, for instance, has proven to be a valuable predictor of academic achievement (Spinath et al., 2014; Vansteenkiste et al., 2005). The self-determination theory proposes two types of motivation that drive students' behavior: A student either displays autonomous motivation (driven by internal variables) or controlled motivation (driven by external variables; Deci & Ryan, 2008). A myriad of studies demonstrate that motivation is able to predict study achievement, with positive effects specifically for autonomous motivation (e.g., Kriegbaum et al., 2018; Vansteenkiste et al., 2005).

Several aspects of personality have also been put forward as predictors of academic achievement. Various studies have shown a link with the personality trait of conscientiousness, which can be defined as the tendency to be organized, achievement-focused, disciplined, and industrious (Poropat, 2009; Schneider & Preckel, 2017). We include one facet of conscientiousness that is especially predictive of outcomes such as academic achievement and retention, namely grit, which is defined as the perseverance to work toward long-term goals and to maintain effort and interest, regardless of contingent obstacles (Duckworth et al., 2007, 2019).

Vocational interests also have a valuable predictive impact on study achievement (Nye et al., 2012; Schelfhout et al., 2019). Holland's (1997) theory of vocational personalities and environments is typically used to depict vocational interests. This theory proposes a hexagonal model with six interest

dimensions, abbreviated as RIASEC: realistic, investigative, artistic, social, enterprising, and conventional (Nauta, 2010). A review by Rounds and Su (2014) has shown that interests can explain up to 5% of the variance in college grades.

Other attitudinal predictors of academic achievement are traits such as academic self-efficacy and metacognition (Richardson et al., 2012). Academic self-efficacy is defined as the confidence in one's ability to attain the desired academic goals (Bandura, 1993). Metacognition can be described as the knowledge of one's own motivation and ability to use self-regulatory techniques during studying (Kitsantas et al., 2008). Both constructs are positively associated with academic performance and/or persistence (Richardson et al., 2012; Robbins et al., 2004; Spada & Moneta, 2014). A trait that is negatively correlated with academic achievement is test anxiety, which is described as feeling anxious in settings related to learning and evaluating (Credé & Kuncel, 2008). In the present study, we control for a wide range of attitudinal variables when assessing the relation between Latin education and academic achievement.

Demographic Variables

The final category of predictors is made up of demographic variables (Richardson et al., 2012), which are not supposed to influence achievement, but often do in reality. In the present study, we include the two most commonly used demographic predictors, namely gender and SES (socioeconomic status). Gender is a prominent demographic predictor of academic achievement: There is a longstanding history in the literature of demonstrating a pervasive female advantage in school performance, starting at the elementary level and ending at the university level (Carvalho, 2016; Su et al., 2009; Voyer & Voyer, 2014). SES is associated with academic achievement: The meta-analyses by White (1982) and Sirin (2005) reported a medium to strong correlation between SES and academic achievement, depending on the way SES is defined (as income, education, and/or occupation of the household head). However, studies by Marks and O'Connell (2021a, 2021b) demonstrate that it is important to separate SES from other variables (e.g., mother's cognitive abilities) when making such claims. Nevertheless, as the literature has also suggested that the learning of Latin is more common for children from a higher socioeconomic background (Bennett, 2021; Sussman, 1978), controlling for SES is particularly important in the present study. Furthermore, Bracke and Bradshaw (2020) noticed that possible confounds like social background were typically not considered in most studies on the benefits of studying Latin, even though social background is confounded with study choice in secondary education, for instance (van de Werfhorst et al., 2003). Bracke and Bradshaw (2020) state

that the research field would benefit from new studies that pay close attention to the role of gender, race, socioeconomic background, and teaching approach. Their remarks about gender and SES are addressed in the present study, as we control for the impact of these two demographic covariates.

Method

The SIMON Project in an Open-Access Study Environment

For the present study, we performed analyses on secondary data gathered within the longitudinal SIMON project of Ghent University (a university within the top 100 of the Shanghai Ranking Consultancy's Academic Ranking of World Universities). Ghent University is located in Belgium, a country with an open-access study system: Every student with a high-school degree has the opportunity to start any program in higher education, except for performance arts, medicine, dentistry, and veterinary medicine (Flemish Agency for Higher Education, Adult Education, Qualifications and Scholarships, 2023). However, data show that success rates in open-access (Belgian) higher education are generally low (OECD, 2017). Consequently, the aim of the SIMON project is to help improve timely degree attainment by providing pupils with an internet-based self-assessment tool that generates nonbinding study (re)orientation advice. An extensive historical data set (with more than 70,000 entries as of 2021) was used to develop an algorithm that could generate study advice. The data set includes both former students' exam scores and their scores on various tests measuring predictors of academic achievement, as discussed in the Introduction. In order to deliver program-specific advice, new students' test results are fed into the algorithm and compared to previous scores. If this comparison shows that the student has a very low likelihood of succeeding, the student is advised to improve their basic skills or to reorient toward a more attainable or suitable study program. High response rates are obtained, as participation in the SIMON project is strongly encouraged among students at the start of their first academic year (Fonteyne, Duyck, & De Fruyt, 2017). After the students finish their 1st year, their exam results are linked to their original data, which ensures a continued improvement of the prediction models.

Data

The data set used in the present study includes test results from the SIMON project collected in 2018 and the subsequent exam results of 1st-year students (mean age = 18 years, $SD = 0.42$) at Ghent University. Data from 1,898 students across 12 bachelor programs were considered (an overview is presented in Table 1). The gender distribution was different for each program, with the

Table 1 Number of students and proportion of Latin students per study program

Program number and acronym	Program or grouping	*n*	% Latin students[a]
	Full data set[b]	1,395	24%
	Non-STEM[c]	943	27%
1 – PSY	Psychology	239	16%
2 – LAW	Law	227	43%
3 – CRIM	Criminology	106	10%
4 – LING	Linguistics and Literary Studies	75	56%
5 – APL LING	Applied Linguistics	74	41%
6 – ECON	Economy	222	16%
	STEM[d]	978	22%
7 – BIO ENG	Bio-engineering Sciences[e]	131	15%
8 – ENG TECH	Engineering Technology[e]	190	14%
9 – ENG	Engineering[e]	187	27%
10 – REHAB SCI	Rehabilitation Sciences and Physiotherapy	199	27%
11 – PHARMA	Pharmaceutical Sciences	130	28%
12 – BIOMED	Biomedical Sciences	118	21%

Note. The sample sizes of the full data set and of the non-STEM and STEM program groups do not necessarily equal the sum of the sample sizes of the programs included in each grouping, due to changes in the predictor lists used for their prediction models (see Procedures and Analyses section). [a]This indicates the percentage of students per study program who studied Latin in secondary education. [b]The full data set is based on the data from all programs except Programs 10 and 12, for which no data on reading comprehension were collected, and Program 9, for which no mathematics test was administered. [c]The non-STEM program group includes Programs 1–6. [d]The STEM program group includes Programs 7–12. [e]Three distinct types of engineering study programs exist, which are all very different. First, engineering technology focuses on a strong foundation in scientific courses and subsequent specialization in a technological domain. The acquired knowledge is application-oriented and focuses on problem solving. Second, the general engineering category (often referred to as civil engineering) has a predominant focus on mathematics, which is applied in more technical courses. Finally, bio-engineering focuses on living matter and provides a synthesis between chemistry and biology, with mathematics and physics providing the bridge to technological applications (Onderwijskiezer, 2023).

proportion of male students ranging from 17% to 89%. Importantly, both Latin and non-Latin students regularly engaged with foreign languages throughout primary and secondary school. From the age of 10, all Flemish students study French, followed by English from 12 to 13 years. Depending on their study program, pupils may also study a third foreign language, such as German or

Spanish, later on in their secondary education curriculum (European Commission, European Education and Culture Executive Agency, 2023). Thus, it is reasonable to assume that all students within the sample had (some) knowledge of at least two foreign languages (i.e., French and English).

Besides exploring each program specifically, we also considered two overarching program groups, namely STEM and non-STEM. The former is defined by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a field that incorporates life and physical sciences, technology, engineering, and mathematics (UNESCO International Bureau of Education, 2016). Intuitively, one may not expect a relation between academic achievement and studying Latin in secondary school for the STEM study field. Such a relation would be more likely for the non-STEM field, where the programs encompass the arts and humanities. By distinguishing between STEM and non-STEM programs in our analyses, we were able to evaluate whether the predictive ability of Latin for academic achievement was equally large for these two groupings. The UNESCO definition of the STEM field was used to divide study programs into either STEM or non-STEM programs.

Ethics Statement

The Ethical Commission of the Faculty of Psychology and Pedagogical Sciences of Ghent University has granted approval to the SIMON project, of which the present study is an integral part. The study was carried out in accordance with the recommendations of the Ethical Commission of Ghent University. All subjects gave their online informed consent in accordance with the Declaration of Helsinki.

Measures

An overview of the set of variables used to construct the predictive models is given in Table 2. Below we provide a full description of the included variables and their reliability. Additional information, including the confidence intervals around the means of these measures, is reported in Appendix S1, Table S1.1, in the Supporting Information online.

Dependent Variable

Our measure of academic achievement is GPA, which indicates the global result of the student in their 1st year on a scale from 0 to 1,000. The inclusion of this measure allows us to compare our findings with the results from the international literature, where this is a common performance outcome measure (Schelfhout et al., 2019).

Table 2 Overview of the variables used to construct the predictive models

Category	Variables
Dependent variable	GPA
Cognitve variables	Mathematics (normal/advanced)[a]
	Vocabulary
	Reading comprehension[b]
	Chemistry[c]
	Physics[d]
	High school GPA
	High school mathematics package
	High school Latin package
	High school Dutch package
Attitudinal variables	Text anxiety
	Motivation (autonomous and controlled)
	Grit
	Academic self-efficacy (comprehension and effort)
	Metacognition (knowledge and regulation)
	Realistic interest dimension
	Investigative interest dimension
	Artistic interest dimension
	Social interest dimension
	Enterprising interest dimension
	Conventional interest dimension
Demographic variables	Gender
	Socioeconomic status

Note. GPA = grade point average. [a] The normal mathematics test was used in Programs 1–5 and 10–11, whereas the advanced mathematics test was used in Programs 6–8 and 12. [b] Not used in Programs 10 and 12. [c] Only used in Programs 8 and 11–12. [d] Only used in Programs 10–12.

Cognitive Predictors

We included data from five tests to assess students' cognitive skills. The tests used are all valid predictors of academic achievement (Fonteyne, Duyck, & De Fruyt, 2017; Fonteyne et al., 2015; Schelfhout et al., 2022). First, mathematical skills were estimated through a normal or advanced test. The administered test depended on the study program a student was in. Both tests included 25 questions, of both multiple-choice and open-ended types. The normal test ($M = 16.91$, $SD = 2.97$, Cronbach's $\alpha = .72$) was administered in Programs 1–5 and 10–11, and the advanced test ($M = 12.31$, $SD = 3.74$, Cronbach's $\alpha = .78$)

in Programs 6–8 and 12. No mathematics test was administered in Program 9. An example of a question from the normal test is "A book that is on a 40% discount costs €18. How much did it cost prior to the discount?" An example of an item from the advanced test is "Present the general equation of a circle with center (−2,1) and radius 3." Second, the Lexical Test for Advanced Learners of English (LexTALE; Lemhöfer & Broersma, 2012) was used to test vocabulary ($M = 17.50$, $SD = 1.93$, Cronbach's $\alpha = .83$) in all programs. Here, students were presented with 60 items, and they had to indicate whether the stimulus was a word or not (i.e., make a lexical decision). Third, we tested reading comprehension ($M = 15.02$, $SD = 4.45$, Cronbach's $\alpha = .78$). Students had to read a one-page English text and were tested with five multiple-choice questions afterwards. This test was administered in all programs, except in Programs 10 and 12. Fourth, a chemistry test ($M = 15.17$, $SD = 3.24$, Cronbach's $\alpha = .71$) was given to students in Programs 8 and 11–12. This test included 25 items such as "What is the total number of valence electrons of a sulfur atom?" Finally, in Programs 10–12, a physics test ($M = 11.52$, $SD = 3.54$, Cronbach's $\alpha = .68$) was given. An example of one of the 25 items is "What is Newton's first law?"

Four variables were used to depict study antecedents. First, we included self-reported high school GPA ($M = 72.41$, $SD = 6.60$). Second, we included the high school mathematics package ($M = 5.39$, $SD = 1.78$), high school Latin package ($M = 1.07$, $SD = 1.80$), and high school Dutch package ($M = 4.01$, $SD = 0.89$). These last three variables comprised the number of hours of instruction in each of these particular subjects in the students' final year of secondary education.

Attitudinal Predictors

The Cognitive Test Anxiety Scale (Cassady & Johnson, 2002) was used to assess test anxiety ($M = 9.93$, $SD = 2.46$, Cronbach's $\alpha = .92$). Students indicated on a Likert scale from 1 to 4 how characteristic of themselves they found 25 items such as "l do not perform well on exams."

Motivation was assessed through the Self-Regulation Questionnaire (Vansteenkiste et al., 2009). Respondents had to indicate how characteristic of themselves different statements were. Controlled motivation ($M = 8.24$, $SD = 3.19$, Cronbach's $\alpha = .88$) was measured using eight items (e.g., "I study because I'm supposed to do this"). Autonomous motivation ($M = 14.95$, $SD = 2.52$, Cronbach's $\alpha = .86$) was also measured with eight items (e.g., "I study because it interests me").

To assess grit ($M = 13.55$, $SD = 1.85$, Cronbach's $\alpha = .73$), the Grit Scale (Duckworth et al., 2007) was administered. This scale contains 20 items (e.g., "I finish whatever I begin"), which respondents rated on a scale from 1 (*not at all like me*) to 5 (*very much like me*).

Academic self-efficacy was measured with an adaption of the College Academic Self-Efficacy Scale (Owen & Froman, 1988). Fourteen items were administered to assess comprehension ($M = 14.827$ $SD = 1.66$, Cronbach's $\alpha = .76$), and eight to assess effort ($M = 15.24$, $SD = 2.02$, Cronbach's $\alpha = .73$). Students used a 5-point Likert scale to estimate how well they would cope with certain situations or tasks (e.g., "Tutor another student").

The Metacognitive Awareness Inventory (Schraw & Dennison, 1994) was used to assess two subscales of metacognition: Knowledge of Cognition ($M = 13.77$, $SD = 2.15$, Cronbach's $\alpha = .87$) and Regulation of Cognition ($M = 13.09$, $SD = 2.07$, Cronbach's $\alpha = .87$). In total, 52 items (e.g., "I know my intellectual strengths and weaknesses") were presented to the respondents. For each item, the students had to respond using a 6-point Likert scale (1 = *completely disagree* to 6 = *completely agree*).

The SIMON-I questionnaire (172 yes-or-no items) was used to assess the students' vocational interest profile (Fonteyne, Wille, et al., 2017; Schelfhout et al., 2019). Scores between 0 and 100 were given to each student on each of the RIASEC scales (recall that the letters of this abbreviation stand for realistic, investigative, artistic, social, enterprising, and conventional dimensions): R ($M = 20.77$, $SD = 25.37$, Cronbach's $\alpha = .93$), I ($M = 34.91$, $SD = 20.75$, Cronbach's $\alpha = .87$), A ($M = 27.77$, $SD = 24.44$, Cronbach's $\alpha = .92$), S ($M = 33.83$, $SD = 25.64$, Cronbach's $\alpha = .92$), E ($M = 33.20$, $SD = 27.49$, Cronbach's $\alpha = .93$), and C ($M = 22.31$, $SD = 23.47$, Cronbach's $\alpha = .91$).

Demographic Predictors

Dichotomous measures were used to assess both gender and SES. The categorization into a low-SES group depended on whether the student met any of the following criteria: receiving a scholarship or having a mother who did not obtain a degree from secondary education. This procedure is based on the practices of the Flemish Department of Education to award extra resources to schools with a high concentration of children from low SES backgrounds (Flemish Department of Education, 2012).

Procedures and Analyses

We used $\alpha < .050$ to interpret statistical significance. To test our hypothesis, we developed regression models using an Akaike's information criterion (AIC)

procedure. This technique allows for minimizing the model's prediction errors (Burnham & Anderson, 2002), which is ideal in the context of predicting individual study achievement. Furthermore, these models are able to explain the sample variance of study results in their respective study programs (Schelfhout et al., 2022). However, because the sample sizes of the linguistic programs were rather small ($n < 100$), we included a correction in order to prevent overfitting (Shmueli, 2010). Indeed, research by Hurvich and Tsai (1989) has shown that a high degree of negative bias is likely to characterize an AIC model in case of small sample sizes. We therefore used a more conservative variant, AICc, that applies a correction for every predictor that joins the model, based on the sample size (Cavanaugh, 1997). This AICc methodology contrasts all possible predictor combinations and chooses the predictor set with the smallest likelihood of information loss as the final model. Afterwards, the prediction of this final model is compared to the results of each student individually. Ultimately, the selected model displays the smallest prediction error across all students. By verifying whether the high school Latin package variable was included in the final predictor combination, and thus added incremental predictive value to the other possible cognitive, attitudinal, and demographic predictors, we were able to develop conclusions for our hypothesis. We not only computed program-specific regression models, but also regression models for two overarching groupings of study programs, STEM and non-STEM. The data set considered for the non-STEM study programs contained information from Programs 1–6. For the STEM study programs, data were included from Programs 7–12.

The predictor list of the models for the overarching groups of STEM and non-STEM study programs did not include data on chemistry and physics, as most programs were not tested on these predictors. Furthermore, the predictor list for the STEM study programs did not include data on reading comprehension, as the students from two STEM study programs did not need to complete the reading comprehension test. Finally, for the STEM study programs, mathematics was not included in the predictor list, as students from Program 9 (Engineering) did not complete a mathematics test.

Results

Before exploring whether studying Latin is included as a variable in the programs' predictive models of academic achievement, we explored the general association between the measures of study antecedents and GPA. The correlations between GPA and these measures are reported in Table 3 (for the full correlation matrix, see Appendix S2 in the Supporting Information online). Most importantly, we found a significant correlation between studying Latin

Table 3 Correlations between grade point average (GPA) and measures of study antecedents

	HS Dutch package		HS Latin package		HS mathematics package		HS GPA		GPA	
	r	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*
HS Dutch package	–									
HS Latin package	.02	.46	–							
HS mathematics package	.04	.14	−.12	<.001	–					
HS GPA	−.01	.74	.16	< .001	−.01	.62	–			
GPA	.05	.08	.15	< .001	.14	< .001	.29	<.001	–	–

Note. This correlation matrix was based on the full data set, namely data from Programs 1–8 and 11 ($N = 1{,}395$; see Procedures and Analyses section). HS = high school.

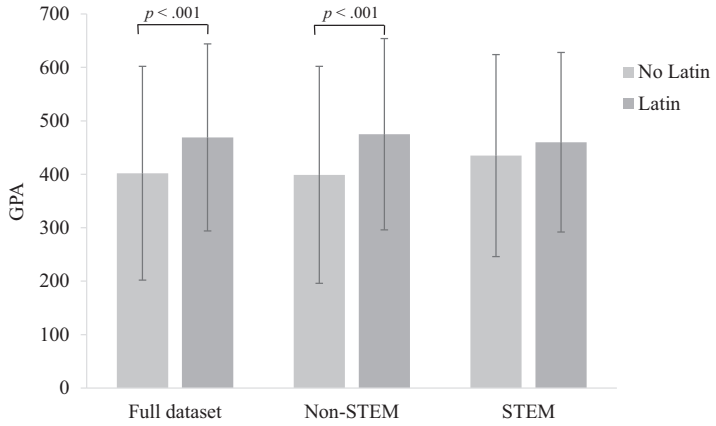

Figure 1 Comparison of mean grade point averages (GPAs). The error bars indicate one standard deviation above and below the mean GPA. The full data set is based on all data except for those from Programs 9, 10, and 12 (see Procedures and Analyses section). STEM = science, technology, engineering, and mathematics.

and GPA of $r(1,393) = .15$, $t(1,393) = 5.51$, $p < .001$, which is comparable to the correlation between the high school mathematics package and GPA, $r(1,393) = .14$, $t(1,393) = 5.23$, $p < .001$.

Second, to get a better indication of the relation between Latin and academic achievement, we compared the mean GPA of Latin students with that of non-Latin students. To do this, we performed independent *t* tests on the full data set, and on the data of the STEM and non-STEM groups separately. The results are reported in Figure 1. For the full data set, a significant difference was found in mean GPA, with a small to medium effect size, $t(639.62) = -5.96$, $p < .001$, $d_s = 0.36$, 95% CI [0.21, 0.51].[1] More specifically, the Latin group had a 16.67% higher mean GPA than the non-Latin group. This effect seems to be driven by the non-STEM study programs, where the Latin group's mean GPA was 19.05% higher than the non-Latin group's, $t(507.20) = -5.57$, $p < .001$, $d_s = 0.40$, 95% CI [0.23, 0.57]. In contrast, the result for the STEM programs, where the Latin group's mean GPA was 5.80% higher than the non-Latin group's, was not significant, $t(379.52 = -1.89$, $p = .060$, $d_s = 0.14$, 95% CI [0.00, 0.33]. In sum, although Latin students exhibited higher GPAs in all cases, this difference was only significant in the full data set and in the non-STEM groups.

After this first indication of a Latin education effect, we tested our hypothesis by exploring whether studying Latin in secondary education is

Table 4 Presence of Latin in program-specific prediction models of academic achievement

Program	Latin in model	R^2 [a]	Unique R^2 [b]	Individual R^2 [c]
Non-STEM	yes	.19	.01	.03
1 – PSY	yes	.14	.02	.03
2 – LAW	yes	.29	.02	.05
3 – CRIM		.24	–	.00
4 – LING	yes	.39	.18	.27
5 – APL LING	yes	.43	.11	.10
6 – ECON		.20	–	.00
STEM		.18	–	.00
7 – BIO ENG		.16	–	.01
8 – ENG TECH		.20	–	.00
9 – ENG	yes	.34	.01	.00
10 – REHAB SCI		.29	–	.00
11 – PHARMA		.28	–	.00
12 – BIOMED		.28	–	.00

Note. [a]The explained sample variance is explained by Nagelkerke's adjusted R^2. [b]Unique R^2 expresses the incremental amount of sample variance explained by the high school Latin package variable. A dash in this column indicates that high school Latin package was not included as a variable in the prediction model. [c]Individual R^2 expresses the amount of sample variance explained by high school Latin package when it is included as the only variable in the prediction model. PSY = Psychology; LAW = Law; CRIM = Criminology; LING = Linguistics and Literary Studies; APL LING = Applied Linguistics; ECON = Economy; BIO ENG = Bio-engineering Sciences; ENG TECH = Engineering Technology; ENG = Engineering; REHAB SCI = Rehabilitation Sciences and Physiotherapy; PHARMA = Pharmaceutical Sciences; BIOMED = Biomedical Sciences.

able to predict study achievement in academic higher education, above and beyond other cognitive, attitudinal, and demographic predictors. We therefore developed program-specific prediction models of GPA (for a full overview of these models, see Appendix S3 in the Supporting Information online).[2] A summary of our results is reported in Table 4. First, in the non-STEM group, the high school Latin package variable was included as a predictor and uniquely explained 1% of the sample variance in GPA. Second, when we specifically analyzed each program, the high school Latin package variable was included as a predictor in the final prediction models of GPA in study programs 1, 2, 4, 5, and 9. For these five study programs, the variance uniquely

explained by high school Latin ranged from 1% to 18%. In sum, these findings are in support of our hypothesis, as including study of Latin as a variable results in a modest but significant contribution to the prediction of academic achievement for some study programs, over and above the best predictors of academic achievement identified in the literature.

Discussion

Although the option to study Latin in secondary education is still present to a considerable extent across Europe (European Commission, European Education and Culture Executive Agency, 2023), its popularity among students has declined in Flanders and across the world (Duyck et al., 2017; Katz et al., 2020). The availability of this study program is often justified based on the assumption that the study of Latin leads to several cognitive benefits, within and beyond the linguistic domain (Devane, 1997; Mavrogenes, 1977). The present study has investigated whether the study of Latin in secondary education is able to predict success rates in higher education. First, we explored differences in mean GPA for Latin in comparison to non-Latin students. Second, we developed prediction models of academic achievement and explored to what extent studying Latin in high school was included as a predictor in these models, above and beyond a wide range of other cognitive, attitudinal, and demographic variables.

We found that Latin students tend to perform better in higher education, as they displayed a substantially (16.67%) higher mean GPA compared to non-Latin students, when we considered the full data set.[3] This finding was largely driven by the non-STEM study programs, as Latin students in these programs especially demonstrated substantially higher GPAs. We observed a similar, though smaller, increase in academic achievement for Latin students in STEM study programs, but this effect was not significant.

Subsequently, we examined the presence of the high school Latin package variable in program-specific prediction models of academic achievement. An important point is that the analyses we used were conservative by design, as no less than 21 cognitive, attitudinal, and demographic predictors of academic achievement were included in the prediction models, many of them assessed with time-consuming tests. The results revealed that Latin was included as a predictor in two thirds of the non-STEM program-specific prediction models, and in the overarching non-STEM model, over and beyond 21 other predictors. Including high school Latin package as a variable in the prediction models resulted in an increase in the explained variance ranging between 1% and 18% for GPA. We acknowledge that the reported magnitude of the predictive effect

of studying Latin in secondary education might seem large, but it is important to consider these effects in the context of an open-access environment. Given that a highly diverse population enters Flemish university education, the variables we included present a wide range of variance. The open-access context contrasts with the closed-access study environments typically reported in the literature, in which the student samples are much more restricted in range, and consequently, sample variances are generally smaller than the actual population variance (Franco-Martínez et al., 2023).

When we further scrutinize the programs that included Latin in their prediction models, we find that the high school Latin package variable was predictive of academic achievement in study programs related to linguistics, as well as in psychology, law, and engineering, which amounts to 57.5% of the total sample tested. However, it is important to note that the sample variance explained uniquely by the high school Latin package variable was much larger in programs related to linguistics in comparison to the other programs. Indeed, the variance in GPA uniquely explained by Latin was 18% for linguistics and literary studies, and 11% for applied linguistics. The finding that the predictive ability of Latin education is particularly large in linguistics programs is not surprising from the perspective of near-transfer effects. Indeed, studying Latin is generally an analytical process, as it is a complex language. By exercising great mental effort in parsing Latin's grammar, students could develop a deeper understanding of how languages are construed (Pelling & Morgan, 2010). Furthermore, Latin is the foundation of many modern foreign languages, thus resulting in many shared grammatical structures and vocabulary roots. This foundation could allow linguistics students to pick up new languages more quickly (Mavrogenes, 1977; Pelling & Morgan, 2010). In sum, our findings could potentially reflect near-transfer effects resulting from studying Latin, but the design of the present study does not allow us to draw conclusions on the precise working mechanism behind such effects.

A noteworthy aspect of the present study is the fact that the declared number of hours of Latin study was based only on students' last year in secondary education. However, students in secondary education in Flanders can opt to change their curriculum at any time. Because of this regulation, some students who indicated that they did not study Latin may still have studied Latin for up to 5 years. For instance, Flemish statistics show that after 4 years of secondary education, about one third of Latin students change their study program and quit studying the classical language (Flemish Department of Education, 2021). In other words, if classical languages yield cognitive benefits, a meaningful part of our control group will also have partially enjoyed

these effects. Therefore, our study may be a conservative underestimation of how much the variable of high school Latin package can contribute to the prediction of academic achievement.

Limitations and Future Directions

As we did not have data available on university college students[4], we could not include them in the present study. Hence, our study only concerns university students, which could lead to an under- or overestimation of the relation between studying Latin in secondary education and later academic achievement. Besides this, the students in the Latin group all stemmed from general secondary education, as this is the only educational track that offers Latin. In contrast, students from the non-Latin group could have studied in general, technical, vocational, or artistic secondary education. As data on educational track were not available in our data set, nor in official databases, we could not control for this variable. Nevertheless, we know that most university students come from general secondary education tracks (89.9% of all 1st-year university students at Ghent University in the academic year 2018–2019 (the population from which we extracted our sample) came from general secondary education; Department of Educational Policy, Ghent University, personal communication, September 7, 2023). Furthermore, this limitation is partially addressed by the fact that we control for a variety of cognitive measures in our prediction models of academic achievement. We encourage future researchers to make a distinction between secondary education tracks and programs, as this could possibly nuance our conclusions. Finally, it is possible that we were not able to detect the predictive ability of studying Latin for academic achievement in each individual study program. Indeed, in some study programs the percentage of Latin students was rather small (e.g., only 10% in criminology), which makes it hard to pick up any effects of the predictor. By also considering overarching groupings of study programs (i.e., STEM and non-STEM), we were able to partially address this concern.

Our findings cautiously support the idea that the predictive effect of studying Latin in secondary school on academic achievement cannot be explained through preselectivity alone. Indeed, the high school Latin package variable was able to predict academic achievement incrementally to no less than 21 cognitive, attitudinal, and demographic variables in a rigorous design, thus rendering a firm preselectivity-only hypothesis less plausible. However, the present noninterventional design alone is not capable of settling this causality debate. Are the advantages observed in Latin students tied to the classical language itself or to other social or attitudinal variables that may have shaped

the choice of studying Latin? Future research could explore the causality of the effects associated with studying Latin and contrast the two views by performing a longitudinal, more controlled study. Such a design could follow and compare students who either take or do not take Latin at the start of secondary education, in their cognitive progress over the years. By matching these students for other cognitive, attitudinal, and demographic predictors, such research could provide a more in-depth insight into the potential benefits of studying Latin, while being able to control for effects of preselectivity.

Conclusion

The present study demonstrated that Latin students exhibit increased levels of study achievement in academic higher education, especially in non-STEM study programs. Furthermore, we found that studying Latin in secondary education is a measurable predictor of academic achievement in non-STEM study programs, over and above other known cognitive, attitudinal, and demographic predictors. We also showed that this relation between studying Latin and academic achievement is not limited to, but is particularly strong in, linguistic study programs. Future research should explore the causal mechanism behind these associations and address whether these effects are the consequence of either preselectivity or cognitive transfer.

Final revised version accepted 29 December 2023

Notes

1 A Cohen's d_s was used to report effect sizes, with 0.01 = very small effect, 0.20 = small effect, 0.50 = medium effect, 0.80 = large effect, 1.20 = very large effect, and 2.00 = huge effect (Sawilowsky, 2009).
2 Multicollinearity of the predictors was examined prior to the analyses, and variance inflation factor (VIF) values were all below 10 (Stevens, 2012).
3 This is an unadjusted effect, that is, the effect we find without taking into account any control variables.
4 The programs taught at university colleges and universities differ in terms of study level, purpose and length. University colleges award professional bachelor degrees, and focus on acquiring comptencies required for the practice of one or more professions. Universities award academic bachelor and master degrees, and focus on broad academic training.

Materials Statement

We hereby provide the link to the platform that holds all the tests that were used in the current manuscript: https://www.vraaghetaansimon.be/login. To access the tests on this platform, creating an account is mandatory, for legal reasons.

References

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, *28*(2), 117–148. https://doi.org/10.1207/s15326985ep2802_3

Barber, G. E. (1985). Latin as a practical study. *The Classical Journal*, *81*(2), 158–160.

Barnett, S. M., & Ceci, S. J. (2002). When and where do we apply what we learn? A taxonomy for far transfer. *Psychological Bulletin*, *128*(4), 612–637. https://doi.org/10.1037/0033-2909.128.4.612

Bennett, D. (2021). A case study into pupil perceptions of Latin, conducted with a mixed-ability Year 9 Latin class at a comprehensive faith school. *Journal of Classics Teaching*, *22*(43), 38–46. https://doi.org/10.1017/S2058631021000052

Bowker, R. (1975). *English vocabulary comparison of Latin and non-Latin students* (Technical Report 831). Boston, MA: Human Engineering Laboratories.

Bracke, E. (2015). Bringing ancient languages into a modern classroom: Some reflections. *Journal of Classics Teaching*, *16*(32), 35–39. https://doi.org/10.1017/s2058631015000185

Bracke, E., & Bradshaw, C. (2020). The impact of learning Latin on school pupils: A review of existing data. *The Language Learning Journal*, *48*(2), 226–236. https://doi.org/10.1080/09571736.2017.1400578

Brandl, K. (2007). *Communicative language teaching in action: Putting principles to work*. Pearson.

Burnham, K. P., & Anderson, D. R. (2002). *Model selection and multimodel inference: A practical information-theoretic approach* (2nd ed.). Springer-Verlag.

Buschkuehl, M., & Jaeggi, S. (2010). Improving intelligence: A literature review. *Swiss Medical Weekly*, *140*, 19–20. https://doi.org/10.4414/smw.2010.12852

Carlisle, J. F., & Liberman, I. Y. (1989). Does the study of Latin affect spelling proficiency? *Reading and Writing*, *1*(2), 179–191. https://doi.org/10.1007/BF00377470

Carvalho, R. G. G. (2016). Gender differences in academic achievement: The mediating role of personality. *Personality and Individual Differences*, *94*, 54–58. https://doi.org/10.1016/j.paid.2016.01.011

Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology*, *27*(2), 270–295. https://doi.org/10.1006/ceps.2001.1094

Cavanaugh, J. E. (1997). Unifying the derivations for the Akaike and corrected Akaike information criteria. *Statistics and Probability Letters*, *33*(2), 201–208. https://doi.org/10.1016/s0167-7152(96)00128-9

Chi, M. T. H., & VanLehn, K. A. (2012). Seeing deep structure from the interactions of surface features. *Educational Psychologist*, *47*(3), 177–188. https://doi.org/10.1080/00461520.2012.695709

Credé, M., & Kuncel, N. R. (2008). Study habits, skills, and attitudes. *Perspectives on Psychological Science*, *3*(6), 425–453. https://doi.org/10.1111/j.1745-6924.2008.00089.x

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*, *49*(3), 182–185. https://doi.org/10.1037/a0012801

de Simoni, C., & von Bastian, C. C. (2018). Working memory updating and binding training: Bayesian evidence supporting the absence of transfer. *Journal of Experimental Psychology: General*, *147*(6), 829–858. https://doi.org/10.1037/xge0000453

Devane, A. K. (1997). Efficacy of Latin studies in the information age. *Educational Psychology*, 1–12.

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, *92*(6), 1087–1101. https://doi.org/10.1037/0022-3514.92.6.1087

Duckworth, A. L., Taxer, J. L., Eskreis-Winkler, L., Galla, B. M., & Gross, J. J. (2019). Self-control and academic achievement. *Annual Review of Psychology*, *70*, 373–393. https://doi.org/10.1146/annurev-psych-010418-103230

Duyck, W., Janse, M., & Soltic, J. (2017). Stem voor Grieks en Latijn: Wat overleeft, leeft. In *Vorming door onderwijs: Humaniora tussen verleden en toekomst* (pp. 169–184). Acco.

European Commission, Directorate-General for Education, Youth, Sport, and Culture. (2018). *The EU in support of the Bologna Process*. Publications Office of the European Union. https://doi.org/10.2766/3596

European Commission, European Education and Culture Executive Agency. (2023). *Key data on teaching languages at school in Europe* (Eurydice report). Publications Office of the European Union. https://doi.org/10.2797/737474

Farsides, T., & Woodfield, R. (2003). Individual differences and undergraduate academic success: The roles of personality, intelligence, and application. *Personality and Individual Differences*, *34*(7), 1225–1243. https://doi.org/10.1016/S0191-8869(02)00111-3

Flemish Agency for Higher Education, Adult Education, Qualifications and Scholarships. (2023). *Naar de hogeschool of universiteit* [Going to university college or university]. https://www.vlaanderen.be/naar-de-hogeschool-of-universiteit

Flemish Department of Education. (n.d.). *Het voltijds gewoon secundair onderwijs* [Full-time general secondary education]. Retrieved January 11, 2022, from https://onderwijs.vlaanderen.be/nl/structuur/secundair/het-voltijds-gewoon-secundair-onderwijs

Flemish Department of Education. (2012). Omzendbrief SO/2012/01 [Newsletter SO/2012/01]. http://data-onderwijs.vlaanderen.be/edulex/document.aspx?docid=14370.

Flemish Department of Education. (2021). *Statistisch jaarboek van het Vlaams onderwijs 2020–2021 [Statistical yearbook of Flemish education 2020–2021]*. https://www.onderwijs.vlaanderen.be/nl/onderwijsstatistieken/statistisch-jaarboek/statistisch-jaarboek-van-het-vlaams-onderwijs-2020-2021

Fonteyne, L., De Fruyt, F., Dewulf, N., Duyck, W., Erauw, K., Goeminne, K., Lammertyn, J., Marchant, T., Moerkerke, B., Oosterlinck, T., & Rosseel, Y. (2015). Basic mathematics test predicts statistics achievement and overall first year academic success. *European Journal of Psychology of Education*, *30*(1), 95–118. https://doi.org/10.1007/s10212-014-0230-9

Fonteyne, L., Duyck, W., & De Fruyt, F. (2017). Program-specific prediction of academic achievement on the basis of cognitive and non-cognitive factors. *Learning and Individual Differences*, *56*, 34–48. https://doi.org/10.1016/j.lindif.2017.05.003

Fonteyne, L., Wille, B., Duyck, W., & De Fruyt, F. (2017). Exploring vocational and academic fields of study: Development and validation of the Flemish SIMON Interest Inventory (SIMON-I). *International Journal for Educational and Vocational Guidance*, *17*(2), 233–262. https://doi.org/10.1007/s10775-016-9327-9

Franco-Martínez, A., Alvarado, J. M., & Sorrel, M. A. (2023). Range restriction affects factor analysis: Normality, estimation, fit, loadings, and reliability. *Educational and Psychological Measurement*, *83*(2), 262–293. https://doi.org/10.1177/00131644221081867

Frey, M. C., & Detterman, D. K. (2004). Scholastic assessment or g? *Psychological Science*, *15*(6), 373–378. https://doi.org/10.1111/j.0956-7976.2004.00687.x

Fromchuck, A. R. (1984). The measurable benefits of teaching English through Latin in elementary school. *The Classical World*, *78*(1), 25–29. https://doi.org/10.2307/4349660

Gerhards, J., Sawert, T., & Kohler, U. (2019). Des Kaisers alte Kleider: Fiktion und Wirklichkeit des Nutzens von Lateinkenntnissen [The emperor's old clothes: Fiction and reality of the benefits of knowledge of Latin]. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, *21*(2), 309–326. https://doi.org/10.1007/s11577-019-00624-8

Gilliland, A. R. (1922). The effect of the study of Latin on ability to define words. *Journal of Educational Psychology*, *13*(8), 501–505. https://doi.org/10.1037/h0072236

Gobet, F., & Sala, G. (2023). Cognitive training: A field in search of a phenomenon. *Perspectives on Psychological Science*, *18*(1), 125–141. https://doi.org/10.1177/17456916221091830

Haag, L., & Stern, E. (2000). Non scholae sed vitae discimus? Auf der Suche nach globalen und spezifischen Transfereffekten des Lateinunterrichts [Non scholae sed vitae discimus? Looking for global and specific transfer effects of Latin teaching]. *Zeitschrift für Pädagogische Psychologie*, *14*(2–3), 146–157. https://doi.org/10.1024/1010-0652.14.23.146

Haag, L., & Stern, E. (2003). In search of the benefits of learning Latin. *Journal of Educational Psychology*, *95*(1), 174–178. https://doi.org/10.1037/0022-0663.95.1.174

Harrison, T. L., Shipstead, Z., Hicks, K. L., Hambrick, D. Z., Redick, T. S., & Engle, R. W. (2013). Working memory training may increase working memory capacity but not fluid intelligence. *Psychological Science*, *24*(12), 2409–2419. https://doi.org/10.1177/0956797613492984

Hodara, M., & Lewis, K. (2017). *How well does high school grade point average predict college performance by student urbanicity and timing of college entry?* U.S. Department of Education Evaluation and Regional Assistance, Regional Educational Laboratory Northwest.

Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Psychological Assessment Resources.

Hurvich, C. M., & Tsai, C. L. (1989). Regression and time series model selection in small samples. *Biometrika*, *76*(2), 297–307. https://doi.org/10.1093/biomet/76.2.297

Jaeggi, S. M., Buschkuehl, M., Shah, P., & Jonides, J. (2014). The role of individual differences in cognitive training and transfer. *Memory & Cognition*, *42*(3), 464–480. https://doi.org/10.3758/s13421-013-0364-z

Jessner, U., Török, V., & Pellegrini, C. (2018). The role of Latin in multilingual learners' strategies. *Language Education and Multilingualism*, *1*, 85–102. https://doi.org/10.18452/19035.2

Katz, J. W., Noels, K. A., & Fitzner, A. R. (2020). Why learn Latin ? Motivation for learning a classical language. *Teaching Classical Languages*, *11*(1), 89–129.

Kitsantas, A., Winsler, A., & Huie, F. (2008). Self-regulation and ability predictors of academic success during college: A predictive validity study. *Journal of Advanced Academics*, *20*(1), 42–68. https://doi.org/10.4219/jaa-2008-867

Kriegbaum, K., Becker, N., & Spinath, B. (2018). The relative importance of intelligence and motivation as predictors of school achievement: A meta-analysis. *Educational Research Review*, *25*, 120–148. https://doi.org/10.1016/j.edurev.2018.10.001

Lemhöfer, K., & Broersma, M. (2012). Introducing LexTALE: A quick and valid Lexical Test for Advanced Learners of English. *Behavior Research Methods*, *44*(2), 325–343. https://doi.org/10.3758/s13428-011-0146-0

Livingstone, J. (2013, January 16). Why you should learn a dead language. *The Guardian*. https://www.theguardian.com/education/2013/sep/16/why-learn-a-dead-language

Lysanets, Y. V., & Bieliaieva, O. M. (2018). The use of Latin terminology in medical case reports: Quantitative, structural, and thematic analysis. *Journal of Medical Case Reports*, *12*(1), Article 45. https://doi.org/10.1186/s13256-018-1562-x

Marks, G. N., & O'Connell, M. (2021a). Inadequacies in the SES–Achievement model: Evidence from PISA and other studies. *Review of Education*, *9*(3), Article e3293. https://doi.org/10.1002/rev3.3293

Marks, G. N., & O'Connell, M. (2021b). No evidence for cumulating socioeconomic advantage: Ability explains increasing SES effects with age on children's domain test scores. *Intelligence*, *88*, Article 101582. https://doi.org/10.1016/j.intell.2021.101582

Masciantonio, R. (1977). Tangible benefits of the study of Latin: A review of research. *Foreign Language Annals*, *10*(4), 375–382. https://doi.org/10.1111/j.1944-9720.1977.tb02999.x

Mavrogenes, N. A. (1977). The effect of elementary Latin instruction on language arts performance. *The Elementary School Journal*, *77*(4), 268–273. https://doi.org/10.1086/461057

Nauta, M. M. (2010). The development, evolution, and status of Holland's theory of vocational personalities: Reflections and future directions for counseling psychology. *Journal of Counseling Psychology*, *57*(1), 11–22. https://doi.org/10.1037/a0018213

Nye, C. D., Su, R., Rounds, J., & Drasgow, F. (2012). Vocational interests and performance: A quantitative summary of over 60 years of research. *Perspectives on Psychological Science*, *7*(4), 384–403. https://doi.org/10.1177/1745691612449021

OECD. (2017). *The state of higher education 2015–2016*. http://www.oecd.org/education/imhe/the-state-of-higher-education-201516.htm

Onderwijskiezer. (2023). *Academic bachelors*. https://www.onderwijskiezer.be/v2/hoger/hoger_acabach.php

Owen, S., & Froman, R. (1988). *Development of a college academic self-efficacy scale* [Paper presentation]. National Council on Measurement in Education, New Orleans, LA, United States.

Pelling, C., & Morgan, L. (2010). *Latin for language learners: Opening opportunity for primary pupils*. Politeia.

Pierre, G., Sanchez Puerta, M. L., Valerio, A., & Rajadel, T. (2014). *STEP skills measurement surveys: Innovative tools for assessing skills*. https://openknowledge.worldbank.org/handle/10986/19985

Pond, F. L. (1938). Influence of the study of Latin on word knowledge. *The School Review*, *46*(8), 611–618.

Poole, P., Shulruf, B., Rudland, J., & Wilkinson, T. (2012). Comparison of UMAT scores and GPA in prediction of performance in medical school: A national study. *Medical Education*, *46*(2), 163–171. https://doi.org/10.1111/j.1365-2923.2011.04078.x

Poropat, A. E. (2009). A meta-analysis of the five-factor model of personality and academic performance. *Psychological Bulletin*, *135*(2), 322–328. https://doi.org/10.1037/a0014996

Richards, J. (2006). *Communicative language teaching today*. Cambridge University Press.

Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: A systematic review and meta-analysis. *Psychological Bulletin*, *138*(2), 353–387. https://doi.org/10.1037/a0026838

Ristikivi, M. (2005). Latin: The common legal language of Europe? *Juridicia International*, *10*, 199–202.

Robbins, S. B., Le, H., Davis, D., Lauver, K., Langley, R., & Carlstrom, A. (2004). Do psychosocial and study skill factors predict college outcomes? A meta-analysis. *Psychological Bulletin*, *130*(2), 261–288. https://doi.org/10.1037/0033-2909.130.2.261

Rombaut, K., Cantillon, B., & Verbist, G. (2006). *Determinanten van de differentiële slaagkansen in het hoger onderwijs* [Determinants of differential success rates in higher education]. Universiteit Antwerpen, Centrum voor sociaal beleid Herman Deleeck.

Roth, B., Becker, N., Romeyke, S., Schäfer, S., Domnick, F., & Spinath, F. M. (2015). Intelligence and school grades: A meta-analysis. *Intelligence*, *53*, 118–137. https://doi.org/10.1016/j.intell.2015.09.002

Rounds, J., & Su, R. (2014). The nature and power of interests. *Current Directions in Psychological Science*, *23*(2), 98–103. https://doi.org/10.1177/0963721414522812

Sawilowsky, S. S. (2009). Very large and huge effect sizes. *Journal of Modern Applied Statistical Methods*, *8*(2), 597–599. https://doi.org/10.22237/jmasm/1257035100

Schelfhout, S., Wille, B., Fonteyne, L., Roels, E., De Fruyt, F., & Duyck, W. (2019). The effects of vocational interest on study results: Student person – environment fit and program interest diversity. *PLoS ONE*, *14*(4), 1–26. https://doi.org/10.1371/journal.pone.0214618

Schelfhout, S., Wille, B., Fonteyne, L., Roels, E., Derous, E., De Fruyt, F., & Duyck, W. (2022). How accurately do program-specific basic skills predict study success in open access higher education? *International Journal of Educational Research*, *111*, Article 101907. https://doi.org/10.1016/j.ijer.2021.101907

Schneider, M., & Preckel, F. (2017). Variables associated with achievement in higher education: A systematic review of meta-analyses. *Psychological Bulletin*, *143*(6), 565–600. https://doi.org/10.1037/bul0000098

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Educational Psychology*, *19*(4), 460–475. https://doi.org/10.1006/ceps.1994.1033

Sheridan, R. (1976). *Augmenting reading skills through language learning transfer: FLES Latin Program Evaluation Reports, 1973–74, 1974–75, 1975–7*. Indianapolis Public Schools.

Shmueli, G. (2010). To explain or to predict? *Statistical Science*, *25*(3), 289–310. https://doi.org/10.1214/10-STS330

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research*, *75*(3), 417–453. https://doi.org/10.3102/00346543075003417

Spada, M. M., & Moneta, G. B. (2014). Metacognitive and motivational predictors of surface approach to studying and academic examination performance. *Educational Psychology*, *34*(4), 512–523. https://doi.org/10.1080/01443410.2013.814196

Sparks, R. L., Ganschow, L., Fluharty, K., & Little, S. (1995). An exploratory study on the effects of Latin on the native language skills and foreign language aptitude of students with and without learning disabilities. *The Classical Journal*, *91*(2), 165–184.

Spinath, B., Eckert, C., & Steinmayr, R. (2014). Gender differences in school success: What are the roles of students' intelligence, personality and motivation? *Educational Research*, *56*(2), 230–243. https://doi.org/10.1080/00131881.2014.898917

Stevens, J. (2012). *Applied multivariate statistics for the social sciences* (5th ed.). Routledge.

Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin*, *135*(6), 859–884. https://doi.org/10.1037/a0017364

Sussman, L. A. (1978). The decline of basic skills: A suggestion so old that it's new. *The Classical Journal*, *73*(4), 346–352.

UNESCO International Bureau of Education. (2016). *Sharing Malaysian experience in participation of girls in STEM education*, https://unesdoc.unesco.org/ark:/48223/pf0000244714

van de Werfhorst, H. G., Sullivan, A., & Cheung, S. Y. (2003). Social class, ability and choice of subject in secondary and tertiary education in Britain. *British Educational Research Journal*, *29*(1), 41–62. https://doi.org/10.1080/0141192032000057366

Vanheule, J. (2015). Latijn en grammaticale competentie in het Nederlands: Een nieuw onderzoek [Latin and grammatical competence in Dutch: A new study]. In K. de Herdt (Ed.), *Taal in tekst: Taalbeschouwing en het Klassieketalenonderwijs* (pp. 87–105). Academia Press.

Vansteenkiste, M., Sierens, E., Soenens, B., Luyckx, K., & Lens, W. (2009). Motivational profiles from a self-determination perspective: The quality of motivation matters. *Journal of Educational Psychology*, *101*(3), 671–688. https://doi.org/10.1037/a0015083

Vansteenkiste, M., Zhou, M., Lens, W., & Soenens, B. (2005). Experiences of autonomy and control among Chinese learners: Vitalizing or immobilizing? *Journal of Educational Psychology*, *97*(3), 468–483. https://doi.org/10.1037/0022-0663.97.3.468

Vantassel-Baska, J. (1987). A case for the teaching of Latin to the verbally talented. *Roeper Review*, *9*(3), 159–161. https://doi.org/10.1080/02783198709553036

Vereeck, A., Janse, M., De Herdt, K., Szmalec, A., Hauspie, C., & Duyck, W. (2023). Why Plato needs psychology: Proposal for a theoretical framework underpinning research on the cognitive transfer effects of studying classical languages. *Psihološka Obzorja /Horizons of Psychology*, *32*, 121–130. https://doi.org/10.20419/2023.32.580

Voyer, D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin*, *140*(4), 1174–1204. https://doi.org/10.1037/a0036620

VVKSO. (2013). *Grieks Latijn tweede graad: Leerplan secundair onderwijs*.

White, K. R. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin*, *91*(3), 461–481. https://doi.org/10.1037/0033-2909.91.3.461

Wiley, P. D. (1984). The impact of high school foreign language study on academic success in college: A 1989 research update. *The Classical Outlook*, *62*(2), 33–36.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Accessible Summary

Appendix S1. Descriptive Statistics.

Appendix S2. Correlations Between Variables.

Appendix S3. Program-Specific Models Predicting Academic Achievement.