



# (How) do self-concept, interest, and conscientiousness function together in academic motivation? A typological approach developed and replicated in two large-scale samples

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## ABSTRACT

**Background:** Following a call for integrative attempts to study academic motivation, we apply a typological approach.

**Aim:** To identify and replicate naturally existing combinations of general academic self-concept, school interest, and conscientiousness.

**Sample:** Two national representative samples of Luxembourgish 9th grade students ( $N > 12,000$ ).

**Method:** Latent profile analysis (LPA) to identify motivation profiles, as well as BCH method and R3STEP approach to relate profiles to academic adjustment and background variables.

**Results:** LPA's revealed six robust motivation profiles, three of which mainly reflect differences in students' general motivation level (i.e., "Highly motivated", "Lowly motivated", and "Amotivated" students). In line with the assumption of synergistic motivation processes in expectancy and value, these differences in motivation strength were reflected uniformly in different indicators of academic adjustment (e.g., standardized test scores and school anxiety). However, we also replicated three profiles whose nature and relation to academic adjustment point to compensatory and interference processes of motivation. While "Self-confident" students, who are characterized by a high general academic self-concept only, showed a better academic achievement as would have been expected by their motivation level, "Unconfident" students showed a rather poor academic adjustment, despite a relatively high interest in schooling and a high conscientiousness. In addition, we found some evidence that for "Conscientiously motivated" students, being highly conscientious may compensate for relatively low interest, seemingly at the cost of relatively high school anxiety.

**Conclusion:** Our typological approach complements previous variable- and person-oriented research on the interplay between expectancy beliefs, value beliefs, and conscientiousness.

## 1. Introduction

Motivation is a key variable in explaining how well students do at school besides their cognitive and meta-cognitive abilities (Credé & Kuncel, 2008; Duckworth, Taxer, Eskreis-Winkler, Galla, & Gross, 2019; Steinmayr, Weidinger, & Wigfield, 2018). This is no wonder, given that students are unlikely to engage behaviorally and especially not cognitively in learning (D'Mello et al., 2017; Reeve & Tseng, 2011), when they see no (good) reason to do so. The relevance of motivation becomes even more pronounced in 21st century education (Hattie, Hodis, &

Kang, 2020; Hidi & Harackiewicz, 2000), when we acknowledge that motivation is not only a prerequisite for learning, but also an outcome of learning and the learning context (e.g., Denissen, Zarrett, & Eccles, 2007; Eccles & Wigfield, 2002; Marsh & O'Mara, 2008; Ryan & Deci, 2020), thereby possibly creating either a virtuous or vicious lifelong learning cycle.

Following a call for integrative attempts to study academic motivation (e.g., Hattie et al., 2020; Linnenbrink-Garcia et al., 2018; Pintrich, 2003), we studied the complex interplay between students' academic self-concept, their interest in schooling, and their conscientiousness via

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a typological (i.e., person-oriented) approach and with respect to different outcomes of schooling (e.g., academic achievement and school anxiety). Doing so, we sought to bring together and address some limitations of previous variable-oriented research on the combined effect of expectancy and value beliefs (Guo, Parker, Marsh, & Morin, 2015; Lee, Freer, et al., 2022; Meyer, Fleckenstein, & Köller, 2019; Nagengast et al., 2011; Trautwein et al., 2012) as well as on the so-called CONIC model (Rieger et al., 2022; Song, Gaspard, Nagengast, & Trautwein, 2020; Trautwein et al., 2015), which suggests that low motivational beliefs can be compensated by high conscientiousness.

To establish symmetry in our latent-profile approach (LPA), we relied on domain-general motivational beliefs (i.e., students' general academic self-concept and interest in schooling) to better map the trait-like character of conscientiousness. To substantiate our findings, we sought to replicate motivational profiles in two nationally representative samples of Luxembourgish 9th grade students. In addition, we used the second sample to take a closer look on the assumed predictive validity of different motivation profiles on academic achievement above and beyond students' prior academic achievement.

### 1.1. The interplay between expectancy and value in education

Education is and has been a main application area of motivation research. Maybe because both common sense and research tells us that a lack of motivation to learn is not only a common phenomenon at least in secondary education (Scherrer & Preckel, 2019), but also a serious threat to students' performance and well-being (Hattie et al., 2020; Hidi & Harackiewicz, 2000; Ryan & Deci, 2020).

A major perspective through which goal-oriented learning behavior can be understood is the distinction between expectancy and value beliefs (e.g., Eccles & Wigfield, 2002). *Expectancy- or competence-related beliefs* refer to students' perceptions about how likely they will be able to achieve a valued goal, to perform a task that leads to this goal, or to their capabilities more generally (e.g., Bandura, 1997; Eccles & Wigfield, 2002; Heckhausen, 1977), whereas *value-related beliefs* refer to the reasons and incentives attributed to learning (e.g., Eccles & Wigfield, 2020; Ryan & Deci, 2020). It is typically emphasized that expectancy and value entertain reciprocal relationships (Denissen et al., 2007; Eccles & Wigfield, 1995; Feather, 1982; Wigfield et al., 1997), for example, we may come to value what we are good at. However, although Atkinson (1957) originally proposed that expectancy and value engage in a multiplicative way to predict achievement-oriented behavior (see also Feather, 1982), and although the  $\times$  in between  $E \times V$  (i.e., expectancy  $\times$  value) theory has become akin to a trademark in motivation research (cf., Nagengast et al., 2011), for a long time, expectancies and values were studied rather independently from each other or in an additive way.

Only recently, researchers have begun to study the multiplicative effects of expectancies and values in the context of learning and education (e.g., Guo et al., 2015; Lee, Freer, et al., 2022; Meyer et al., 2019; Nagengast et al., 2011; Trautwein et al., 2012). For example, Nagengast et al. (2011) showed that science self-concept (as proxy for expectancy), enjoyment of science (as proxy for value), and their interaction all had statistically significant positive effects on engagement in science activities. More specifically, they found evidence for a non-compensatory, synergistic combination of expectancy and value in bringing about motivation, meaning that it may not be enough to either see high value in learning or think that one is good at learning. Rather, both motivational beliefs need to be existent at least to some extent to spur academic engagement, and motivation will be highest when both expectancy and value are high. Complementary, when predicting academic achievement, Trautwein et al. (2012) found that high value beliefs could not compensate for low expectancy beliefs in predicting academic achievement. In fact, and somewhat unexpectedly, such a combination (i.e., high value  $\times$  low expectancy) was particularly detrimental, as students' achievements were found to be even lower compared to a constellation where both expectancy and value beliefs were low. Hence,

these findings, which later were replicated by Meyer et al. (2019), point to a potential interference process of low expectancy beliefs. In other words, the effect of value seems to depend on students' expectancy beliefs: For students with high academic expectancies, high values beliefs may result in high academic adjustment (i.e., synergistic effect), but for students with low expectancy beliefs, a high value may come at a cost (i.e., interference effect).

Although interaction effects in the above cited studies were rather small, depending on the specific indicator for value, expectancy, and academic adjustment, they highlight the theoretical potential of acknowledging combinations of multiple motivation indicators. However, such variable-oriented approaches tell us little about the typicality of certain motivational combinations in real-world contexts, they may reach a limit when considering more than two motivation variables, and they typically require large sample sizes (Lee, Friedman, Christiaans, & Robinson, 2022; Nagengast et al., 2011; Perez et al., 2019). Therefore, person- or profile-oriented approaches have been identified as a useful complement to study the complex interplay between several motivation parameters in education (Grund, 2013; Hayenga & Corpus, 2010; Linnenbrink-Garcia et al., 2018; Marsh, Lüdtke, Trautwein, & Morin, 2009; Pastor, Barron, Miller, & Davis, 2007; Pintrich, 2003; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009; Wormington & Linnenbrink-Garcia, 2016). In such typological approaches, all possible combinations of several operating factors can be regarded at once within groups of individuals, thereby providing a holistic picture of how (academic) motivation typically unfolds (Magnusson, 1998). In addition, different types or profiles of students can be further described (e.g., in terms of background characteristics) and studied in relation to indicators of academic adjustment.

In this respect, Gaspard, Wille, Wormington, and Hulleman (2019) studied combinations of expectancy and value with regard to academic achievement and choices. They found four different profiles highlighting congruent subject-specific motivation and achievement/choices, in which expectancy and value beliefs always co-occurred on a symmetric level (i.e., "low", "moderate", and "high motivation" for Math and English, respectively; see also Fong, Kremer, Hill-Troglin Cox, & Lawson, 2021), indicating a close positive relationship between both motivational dimensions, as suggested by theory (e.g., Eccles & Wigfield, 2002). A similar pattern has been reported by Lazarides, Dicke, Rubach, Oppermann, and Eccles (2021) when investigating life transitions and by Linnenbrink-Garcia et al. (2018) with respect to academic engagement and achievement. Hence, these studies indirectly challenge the theoretically meaningful interference effect of low expectancy beliefs reported by Trautwein et al. (2012) and Meyer et al. (2019), mainly because no group of students showed low expectancies and high values at the same time.

Only when studies applied a more fine-grained perspective on the value component, including motivational costs (e.g., emotional costs of learning), as specified in situated expectancy-value theory (e.g., Eccles & Wigfield, 2020), some notable shape differences in students' motivation profiles emerged (Dietrich, Moeller, Guo, Viljaranta, & Kracke, 2019; Hsieh, Simpkins, & Eccles, 2021; Lee, Friedman, et al., 2022; Perez et al., 2019). However, by and large, these differences in profile shape were observed mainly within different aspects of value beliefs (e.g., attainment value behaved differently than intrinsic and utility values between profiles, Hsieh et al., 2021) or with regard to the value/cost ratio (Perez et al., 2019), not with regard to the expectancy/value or the expectancy/cost ratio.

### 1.2. The interplay between value, expectancy, and conscientiousness

In a further attempt to study complex interactions in the realm of academic motivation, recent research on the CONIC (CONscientiousness  $\times$  Interest Compensation) model expanded the expectancy-value perspective to the trait of conscientiousness (Rieger et al., 2022; Song et al., 2020; Trautwein et al., 2015). By and large, conscientiousness has

been identified as the one Big Five domain that shows the most consistent and substantial positive relationship with general (Barrick, Mount, & Judge, 2001) and academic performance (Duff, Boyle, Dunleavy, & Ferguson, 2004; Franzen et al., 2021; O'Connor and Paunonen, 2007; Poropat, 2009). Going beyond these bivariate correlations, Trautwein et al. (2015) proposed and found a multiplicative effect for conscientiousness and academic interest with regard to self-reported academic effort expenditure. The relationship between conscientiousness and effort expenditure was higher when academic interest was low and the relationship between interest and effort expenditure was higher when conscientiousness was low, indicating a compensatory effect between conscientiousness and interest when it comes to academic motivation. Compared to the expectancy-value interaction described above (e.g., Meyer et al., 2019; Trautwein et al., 2012), this effect was also small, yet somewhat less stable across school domains and outcomes (Song et al., 2020). There is also initial evidence that high conscientiousness can compensate for low expectancy beliefs (i.e., a low academic self-concept) in a similar way, at least in certain subject domains (Trautwein et al., 2015), and for low utility beliefs (Song et al., 2020).

How exactly this compensation works is not yet clear, but it arguably has something to do with the motivational core of conscientiousness, a personality characteristic that can be understood as a motivational reaction norm covering "the tenacity of goal pursuit under distracting circumstances" (Denissen & Penke, 2008, p. 1285), as well as a willingness to comply with rules (Costantini, Sarauili, & Perugini, 2020). In this sense, Trautwein et al. (2015) noted that "activities driven by conscientiousness have a very different 'feel' than do 'interesting' activities" (p. 159), which points to the potential downside of such a form of motivated behavior. For example, whereas engagement out of interest and intrinsic value can be considered a rather adaptive form of motivation given its beneficial relationships to both students' performance and well-being (Howard, Bureau, Guay, Chong, & Ryan, 2021; Ryan & Deci, 2020; Sansone & Harackiewicz, 2000), more controlled forms of motivation showed positive relationships with academic performance, but also with indicators of ill-being (Howard et al., 2021).

## 2. The present study

A shared understanding seems to have crystalized that students need to see value in school-related engagement *and* feel capable to do so, in order to be or become motivated and show persistence (Gaspard et al., 2019; Linnenbrink-Garcia et al., 2018; Nagengast et al., 2011; Wigfield et al., 1997). However, there is also some indication that low expectancy beliefs are particularly problematic when it comes to academic adjustment (Meyer et al., 2019; Trautwein et al., 2012), and that high conscientiousness can compensate for low motivational beliefs (Rieger et al., 2022; Song et al., 2020; Trautwein et al., 2015). Although Trautwein et al. (2015) found some evidence that not only deficit value beliefs (i.e., interest) but also deficit expectancy beliefs (e.g., self-concept and competency beliefs) can be compensated by high conscientiousness, we know of no study that explored the interplay between expectancy, value, and conscientiousness simultaneously.

We addressed this gap by taking a typological (i.e., person-oriented) approach to academic motivation based on students' academic self-concept, interest, and conscientiousness. Such an approach, first of all, has the advantage of *identifying* and *describing* natural configurations of academic motivation among groups of students comprehensively, meaning that any possible combination of variables that actually exists in a real-life context can be identified and studied further. For example, although Trautwein et al. (2012) and Meyer et al. (2019) have found evidence for an interference effect of low expectancy and high value beliefs on students' academic adjustment, it is unclear how robust and typical such a combination actually is (Lee, Friedman, et al., 2022). Hence, a typological approach may tell us something about the practical relevance of a certain motivational combination.

Secondly, by relating such motivation profiles to students' academic

achievement and well-being, we can learn something about potential synergistic, compensatory, and, possibly, interference effects among several motivational variables. Hence, in search for mechanisms of action in motivation, we can re-study the effects typically found in variable-oriented research by using a typological approach. For example, should we find a profile where high expectancy and value beliefs co-occur in students, we should observe the most optimal academic adjustment (e.g., academic achievement), reflecting synergistic motivation processes (e.g., Lee, Freer, et al., 2022). Should we find a profile where relatively low value (and/or expectancy) beliefs, combined with high conscientiousness, still result in good academic adjustment, we have indication for a compensatory effect of conscientiousness over motivational beliefs (e.g., Trautwein et al., 2015).

Although it was not our focal goal to study such processes of motivational development, we, thirdly, acknowledged the contextualization of motivation by relating existing motivation profiles to background variables such as students' gender and the respective school track students attended (cf., Eccles, Wigfield, Harold, & Blumenfeld, 1993; Fong et al., 2021; Gaspard et al., 2019; Hsieh et al., 2021; Lazarides et al., 2021).

In the present study, we analyzed large-scale data from the Luxembourg school monitoring programme *ÉpStan (Épreuves Standardisées)* in two consecutive waves of 9th graders. Given the state of the art of person-oriented research (e.g., Gaspard et al., 2019; Lazarides et al., 2021; Linnenbrink-Garcia et al., 2018), we assumed that expectancy and value typically co-occur and show a synergistic pattern in bringing out academic adjustment, so that we can mainly expect profiles of students that differ in the level of their motivational beliefs (e.g., high, medium, and low scores on both interest and academic self-concept). Accordingly, given the role that is typically ascribed to motivation in school (Linnenbrink-Garcia & Patall, 2016), we expected a positive linear trend, whereby profiles reflecting mainly differences in the level of motivation would be related to students' levels of academic adjustment, with students being "more" motivated showing a better academic performance and feeling better at school.

However, we were especially attentive with regard to motivation profiles that differ in shape, because then, we actually may observe process and outcome patterns that go beyond uniform synergistic processes of motivation (e.g., Meyer et al., 2019). In this sense, the inclusion of students' conscientiousness seems particularly informative. Based on recent findings on compensatory effects of conscientiousness (Di Domenico & Fournier, 2015; Rieger et al., 2022; Song et al., 2020; Trautwein et al., 2015), we looked out for a motivation profile where high conscientiousness compensates for low motivational beliefs, thereby securing academic adjustment via self-discipline (cf., Duckworth & Seligman, 2005).

Our general rationale was the following: In the 2018 wave of 9th graders (i.e., Sample 1), we initially explored motivation profiles based on existing measures of general academic self-concept as a proxy for expectancy, general interest as a proxy for value, and conscientiousness. We also accounted for a broad spectrum of academic adjustment by distinguishing between academic achievement (e.g., standardized test scores in Math) and well-being (e.g., school satisfaction). Hence, in contrast to previous research that studied expectancy and value with regard to specific subjects (e.g., Gaspard et al., 2019; Nagengast et al., 2011; Trautwein et al., 2015), we decided to approach our research questions from a domain-general perspective, in order to achieve the greatest possible symmetry among the variables we used. For example, when predicting school satisfaction as a general aspect of academic adjustment, the relative importance of students' academic self-concept and interest compared to their conscientiousness may be underestimated when relying on subject-specific operationalizations of expectancy and value (Gogol, Brunner, Martin, Preckel, & Goetz, 2017). For the same reason, we also included mean scores of academic achievements across subject domains. Finally, we included school anxiety as an emotional component of ill-being, in order to account for

potentially differential effects of certain forms of motivation (cf., Howard et al., 2021).

In the consecutive 2019 wave of 9th graders (i.e., Sample 2), we then sought to replicate and extend findings from the prior analyses to a) verify the robustness of motivation profiles and to b) better substantiate motivation as a predictor of academic adjustment. Concerning the latter, we included students grades in Math, German, and French prior and after ÉpStan 2019 assessments as further indicators for academic achievement in addition to standardized test scores in these domains. This allowed us to test the predictive validity of students' motivational profiles for academic achievement above and beyond students' prior academic achievement.

In the following, we first describe the sample, procedure, measures, and analyses for both data subsets at once, given major similarities. We then present the results for each sample separately, followed by a general discussion.

### 3. Method

#### 3.1. Participants and procedure: Samples 1 and 2

The study is based on secondary analysis of data collected for two consecutive national cohorts of students in 9th grade. Data was collected as part of the Luxembourg school monitoring programme (ÉpStan; Fischbach, Ugen, & Martin, 2014; Ugen, Fischbach, Reichert, Dierendonck, & Martin, 2014). The school monitoring programme, administered each year in grade 1, 3, 5, 7 and 9 (see <https://epstan.lu>), focuses on the academic performance of children during their compulsory schooling (for a German description of the Luxembourgish school system see Lenz & Heinz, 2018; for an English description see <https://eu.rydice.eacea.ec.europa.eu/national-education-systems/luxembourg/lu-xembourg>). For grade 9, the academic performance includes three domains: Mathematics, German reading comprehension, and French reading comprehension. In addition, students completed questionnaires concerning their school motivation, work habits, and attitudes toward school as well as their socio-demographic background. The mathematics test and questionnaires are available in German and French (the two main languages of instruction in schools) and students are free to answer any question in either of the languages. Although participation is compulsory for the schools, students and their parents/legal guardians are informed beforehand and can choose to opt-out. ÉpStan has a proper legal basis and is fully compliant with the European GDPR. Prevalent ethical standards (e.g., 1964 Helsinki declaration) were followed in the conduct of the study, a trusted-third-party-solution ensured the privacy of the participants, and anonymized data was used in all statistical analyses.

The student population in Luxembourg is characterized by a high socio-economic and -cultural diversity (Lenz & Heinz, 2018). The current study cohorts include all 9th grade students enrolled in the Luxembourg public education system in November 2018 (Sample 1:  $N = 6,279$ , 51.7% male) and November 2019 (Sample 2:  $N = 6,493$ , 52.0% male). For the 2018 cohort students' ages ranged from 13 to 25 years, with most students (92%) born between 2002 and 2004. Similarly, for the 2019 cohort students ages ranged from 13 to 24 years, with most students (91.1%) born between 2003 and 2005. Secondary education in Luxembourg is characterized by tracking. After six years of primary education, students are grouped in three different school tracks based on their academic achievement. For the 2018/2019 cohorts, 28.5/27.6% of students in Grade 9 attended the Highest track, 61.6/62.0% the middle track, and 9.9/10.5% the lowest track, respectively.

#### 3.2. Measures: Samples 1 and 2

##### 3.2.1. Indicators for motivation profiles

As indicators for expectancy and value we used measures of general academic self-concept and general academic interest, respectively, in

addition to conscientiousness. For all three scales, items are rated on a 4-point scale ranging from 1 (disagree) to 4 (agree). Cronbachs' alpha coefficients for all self-report measures in the present study are displayed in Table 1.

The *general academic self-concept* scale (3 items, e.g., "I get good marks in most school subjects") is based on the Self-Description Questionnaire (Marsh, 1990; Marsh & O'Neill, 1984) and previously showed satisfactory psychometric properties with reported omega coefficients ranging from .75 to .85 (Gogol et al., 2014, 2017) and Cronbachs' alpha of .77 (Keller et al., 2019).

The *general academic interest* scale (3 items, e.g., "I am interested in most school subjects") was adopted from studies by Gogol and colleagues (Gogol, Brunner, Preckel, Goetz, & Martin, 2016, 2017). In accordance with theoretical frameworks (e.g., Krapp, 2002), the measure taps into feelings of personal importance, emotional value, and global interest. Reported reliability estimates for the scale were satisfactory to good with omega coefficients ranging from .77 to .81 (Gogol et al., 2017) and Cronbachs' alpha of .78 (Keller et al., 2019).

The *conscientiousness* scale (4 items, e.g., "I am diligent") builds on existing Big Five inventories (e.g., John, Donahue, & Kentle, 1991; Rammstedt & John, 2007) and focuses on students' behaviors that reflect striving for academic success and previously showed satisfactory reliability ( $\alpha = .75$ ; Keller et al., 2019).

For all three motivation indicators, ICCs were smaller than .03 at school level, and smaller than .06 at class level in both samples. This indicates that motivation differs to a very large degree between students, thereby justifying our person-oriented approach.

##### 3.2.2. Academic adjustment

Academic achievement was measured by the ÉpStan comprehensive standardized tests of *Mathematics*, *German reading comprehension*, and *French reading comprehension* ( $M = 500$ ;  $SD = 100$ ). The standardized test scores reflect students' competency level in different academic domains in relation to standards set by the Ministry of Education (Fischbach et al., 2014). Competence scores are estimated based on Rasch models using Weighted Likelihood Estimates, and satisfactory to good reliabilities ( $\alpha > .75$ ) have been reported for all scales (Gogol et al., 2014; Keller et al., 2019). Different test versions are tailored to adequately assess the assumed competency level at each school track. Yet, because each version entails at least one third of overlapping tasks that function as anchor items, the comparability of competencies across school tracks is ensured (Fischbach et al., 2014). To account for possible language effects, items whose difficulty showed a significant language dependency (i.e., a test item was more difficult for students who answered

**Table 1**  
Variable overview (Sample 1 and Sample 2).

Variables	# items	Sample 1 (9th graders of the 2018 cohort)		Sample 2 (9th graders of the 2019 cohort)	
		N	$\alpha$	N	$\alpha$
Motivation indicators					
Self-concept	3	6,235	.76	6,451	.76
Interest	3	6,232	.74	6,451	.77
Conscientiousness	4	6,239	.73	6,455	.73
Academic adjustment					
German competency		5,808		5,946	
French competency		6,263		6,479	
Math competency		6,262		6,479	
School anxiety	3	6,229	.77	6,445	.78
School satisfaction	3	6,070	.64	6,340	.65
German grade class 8				3,982	
French grade class 8				4,236	
Math grade class 8				4,237	
German grade class 9				5,248	
French grade class 9				5,604	
Math grade class 9				5,567	

it in German compared to French or the other way around) have been removed during test development.

Two indicators were used to measure academic well-being: school satisfaction and school anxiety. For both scales, items are rated on a 4-point scale ranging from 1 (disagree) to 4 (agree). The *school satisfaction* scale (3 items, e.g., “I like going to school”) focuses on students’ perceived contentment with school and previously showed acceptable internal consistency ( $\alpha = .67$ , Gogol et al., 2014). The *school anxiety* scale (Gogol et al., 2014) is derived from the Test Anxiety Inventory (Spielberger, 1980) as well as the Academic Emotions Questionnaire (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011) and contains three items (e.g., “I am afraid of most school subjects”). McDonald’s reliability estimates ranged from .78 to .83 (Gogol et al., 2016, 2017).

For the 2019 cohort, we also obtained final grades in Math, German, and French from state records for the academic year prior to (i.e., students’ final school grades in class 8, year 2018/2019) and following (i.e., students’ final school grades in class 9, year 2019/2020) ÉpStan assessments, which took place in November 2019. In Luxembourg, grades range from 0 to 60 (with higher grades indicating better achievement). Note, however, that for the lowest track it was not possible to derive a comparable final grade in these subjects, given that the curriculum in this track differs considerably from the one in the middle and highest track. Hence, in Sample 2, the prediction of grades by motivation profiles is based on students in the middle and high track only.

### 3.2.3. Sociodemographic variables

The questionnaire also entailed questions regarding students’ gender. In addition, the respective school track students attended during the ÉpStan assessments was encoded.

## 3.3. Data analysis: Samples 1 and 2

### 3.3.1. Data overview and preparation

Table 1 gives an overview of the number of cases per variable. For German competency scores, case numbers are considerably lower, as in some schools in Luxembourg German is not offered as a school subject. In addition, somewhat fewer cases can be observed for school satisfaction. This may be because this measure is presented at the end of the ÉpStan assessments and there is a certain time limit. Because missing values on these designated criterion variables occurred rarely (i.e., 3% or less in both samples), no data imputation was applied. In addition, missing values on the indicator variables for motivation profiles were less than 1% in both samples. Because we saw no clear reason for any systematic dropout here, we carried-out the profile analyses based on all the available data using the FIML approach implemented in Mplus. For academic achievement, we created a mean performance score for students who provided data for at least two subject domains.

### 3.3.2. Motivation profiles

In order to identify groups of students with qualitatively different forms of motivation, we relied on latent profile analysis (LPA; Magidson & Vermunt, 2004). Similar to cluster analysis (CA), LPA aims at identifying subgroups of cases (i.e., individuals in the present case) that share a similar pattern on relevant continuous indicator variables. However, different to CA, LPA is a model-based technique that offers several fit parameters to facilitate and objectify the decision on the number of different latent classes (i.e., motivation profiles) that eventually are to be distinguished. In the following, we will refer to the sample-size-adjusted Bayesian Information Criterion (SSA-BIC) and likelihood tests (e.g., Lo–Mendell–Rubin likelihood, LMR; Parametric bootstrapped likelihood, PB) to compare the different models (cf., Magidson & Vermunt, 2004; Nylund, Asparouhov, & Muthén, 2007; Tofghi & Enders, 2007). In addition, we inspected entropy values, where values  $> .70$  indicate a good classification accuracy (Reinecke, 2006). However, as suggested by Marsh, Hau, and Wen (2004), we also considered theoretical aspects in the evaluation of model solutions.

More specifically, we were especially attentive towards motivation profiles that differ not only in terms of profile level but also profile shape. Using Mplus Version 8 and its robust maximum-likelihood estimator (MLR) via the EM algorithm, which corrects test statistics and standard errors for non-normality in the indicator variables (Muthén & Muthén, 1998-2015), we evaluated models between two and ten latent classes, which are assumed to have caused heterogeneity among the observed indicators (Magidson & Vermunt, 2004). In the present study these observed indicators included the mean scores for general academic interest, general self-concept, and conscientiousness. Following similar studies on motivation profiles (e.g., Lazarides et al., 2021; Linnenbrink-Garcia et al., 2018) and because we were mainly interested in mean level differences of the different motivation indicators, we applied the default option in Mplus in which variances are fixed but means can differ between motivational profiles. To avoid the problem of local maxima, we increased the default number of starting values from 100/10 to 500/100 and we increased the number of initial stage iterations from 10 to 50. Using the type = complex command, we also accounted in all following models for the nested data structure at the class level, where ICCs were largest.<sup>1</sup>

### 3.3.3. Relating motivation profiles to academic adjustment and background variables

We then applied two different approaches to relate the latent profiles to the different indicators for students’ academic adjustment and background variables, respectively. In both approaches, individuals are first assigned to the most likely profile. Subsequently, the most likely class membership is related either to certain criteria or predictors. In a first step, we applied the BCH method (Asparouhov & Muthén, 2014a; 2014b), which accounts for measurement error in the latent profile variable when using it as a predictor for different continuous criterion variables. That is, by using logit probabilities for each individual (instead of the assigned class as such), the uncertainty of class membership is taken into account, which results in less biased estimates and maintains a stable profile solution (Asparouhov & Muthén, 2014a; 2014b). To facilitate interpretation, we z-standardized the criterion variables. This way, profile differences on a criterion can be interpreted in the same manner as Cohen’s *d* (cf., Gaspard et al., 2019). In a second step, we applied the R3STEP approach implemented in Mplus (Asparouhov & Muthén, 2014a) to use gender and school track as categorical predictor variables for the latent profile variable. To do so, we created two dummy variables, with the first dummy taking the highest school track as reference category and the second dummy taking the middle school track as reference category. Note that the FIML procedure is currently not supported for three-step procedures in Mplus. Therefore, sample sizes vary depending on the respective criterion or predictor variable.

## 4. Results Sample 1 (“Identifying motivation profiles”)

### 4.1. Preliminary descriptive and bivariate analyses

Table 2 shows the descriptive results and bivariate correlations (upper triangle) for the study variables. It can be seen that all three motivation indicators showed substantial relationships to the different indicators of academic adjustment, whereas effect sizes were relatively largest, yet still only small to medium in size, for general academic self-concept. Bivariate correlations between the different motivation indicators were large in size, as were bivariate correlations between the

<sup>1</sup> Accounting for nested data does not affect profile identification. However, it may affect subsequent analyses using these profiles, for example, to predict academic achievement. We therefore repeated all analyses while accounting for the nested data structure at the school instead of the class level, which did not affect the interpretation of the presented findings.

**Table 2**  
Descriptive statistics and bivariate relationships\* (Sample 1 and Sample 2).

	Sample 1		Sample 2		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>																		
Background variables																						
Gender <sup>a</sup> (1)	1.48	.50	1.48	.50		.01	.09	.20	.08	.13	-.09	.04	.22	.09	-	-	-	-	-	-	-	-
Motivation indicators																						
Self-concept <sup>b</sup> (2)	2.88	.60	2.88	.60	.01		.42	.51	.24	.20	.21	.25	-.14	.24	-	-	-	-	-	-	-	-
Interest <sup>b</sup> (3)	2.71	.70	2.75	.71	.11	.41		.50	-.02	.01	-.06	-.03	.14	.32	-	-	-	-	-	-	-	-
Conscientiousness <sup>b</sup> (4)	3.05	.63	3.06	.63	.20	.48	.49		.11	.15	.08	.13	.09	.30	-	-	-	-	-	-	-	-
Academic adjustment																						
German competency (5)	513.30	105.18	518.51	112.91	.09	.25	.02	.11		.52	.60	.85	-.16	.21	-	-	-	-	-	-	-	-
French competency (6)	487.61	118.94	493.88	106.29	.09	.18	.02	.10	.48		.50	.81	-.04	.20	-	-	-	-	-	-	-	-
Math competency (7)	506.64	100.83	506.99	98.04	-.08	.19	-.05	.04	.55	.48		.84	-.16	.18	-	-	-	-	-	-	-	-
Mean test performance (8)	501.51	90.39	505.29	87.07	.04	.25	-.01	.10	.84	.81	.82		-.14	.24	-	-	-	-	-	-	-	-
School anxiety <sup>b</sup> (9)	2.24	.80	2.25	.81	.23	-.18	.13	.09	-.11	-.02	-.13	-.10		-.04	-	-	-	-	-	-	-	-
School satisfaction <sup>b</sup> (10)	2.94	.75	2.97	.76	.08	.26	.33	.30	.20	.18	.18	.23	-.04		-	-	-	-	-	-	-	-
Only Sample 2																						
German grade class 8 (11)	-	-	38.70	7.82	.23	.39	.12	.25	.50	.23	.34	.46	-.10	.23	-	-	-	-	-	-	-	-
French grade class 8 (12)	-	-	37.80	8.31	.21	.32	.10	.31	.20	.48	.23	.38	.04	.20	.41	-	-	-	-	-	-	-
Math grade class 8 (13)	-	-	36.66	10.21	.08	.37	.10	.24	.34	.29	.44	.44	-.10	.23	.54	.52	-	-	-	-	-	-
Mean grade class 8 (14)	-	-	37.72	7.19	.20	.44	.13	.32	.42	.40	.42	.52	-.06	.27	.78	.78	.88	-	-	-	-	-
German grade class 9 (15)	-	-	39.37	8.07	.21	.36	.13	.25	.45	.20	.28	.39	-.10	.22	.67	.33	.45	.58	-	-	-	-
French grade class 9 (16)	-	-	38.15	8.44	.23	.29	.12	.31	.10	.44	.17	.30	.04	.16	.32	.69	.40	.58	.34	-	-	-
Math grade class 9 (17)	-	-	36.66	11.25	.07	.34	.12	.23	.25	.22	.35	.34	-.09	.23	.45	.41	.67	.64	.48	.43	-	-
Mean grade class 9 (18)	-	-	38.02	7.38	.19	.41	.15	.33	.33	.36	.35	.43	-.07	.26	.59	.58	.64	.74	.75	.74	.86	-

Note. \*Correlations above the diagonal (i.e., upper triangle) pertain to Sample 1; correlations below the diagonal (i.e., lower triangle) pertain to Sample 2. Correlations above |.03/.04/.06| are significant ( $p < .05/.01/.001$ ).

<sup>a</sup> Gender: male = 1, female = 2.

<sup>b</sup> Scale range from 1 to 4. School track as a three-level nominal variable is not shown.

different standardized test scores.

In terms of absolute values, it can be seen that motivation towards schooling was generally rather high, especially in terms of students' conscientiousness, given a scale range from 1 to 4. Students also reported to be rather satisfied with school in general and to experience relatively low school anxiety. Finally, standardized test scores descriptively were a bit higher for German and Math compared to French.

#### 4.2. Motivation profiles

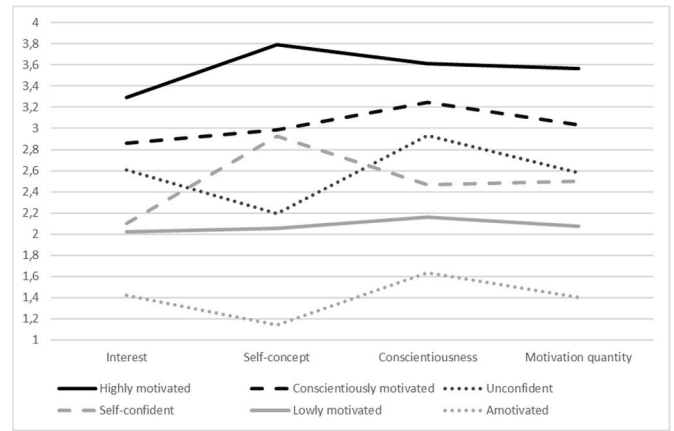
Table 3 (upper part) displays the fit parameter and entropy values for the different models. It can be seen that both the SSA-BIC parameter and the PB test yielded little informative value on which model to prefer, given that the SSA-BIC value decreased steadily with more complex models up to eight latent classes (with light edges at two, four, and six classes as indicated by elbow plots) and the PB test always favored the more complex model as well (i.e.,  $k$  versus  $k-1$  latent classes). However, from the entropy values, it can be seen that models with more than four latent classes showed a better classification security than models with four or less classes. It also can be seen that for models with six or less classes, the LMR test indicated that models with  $k$  classes are favored over more economical models (i.e.,  $k-1$ ) with  $p < .00001$ . For models with eight and 10 classes, no substantial gain was observed. Finally, for models with seven and more classes, more than one class contained very few students (i.e., 2% or less of all cases). Based on these numbers, we decided that either the 5- or 6-class solutions would be reasonable to further explore. However, when we examined both solutions in more detail, we observed that only in the 6-class solution, three motivation profiles that did not only differ considerably in level but also shape were identified. Given our initial research goals, we therefore report on this solution in detail. In the following, we describe those profiles in the order of generally rather high to low motivation (see also Fig. 1 and Table 4). In line with our typological perspective, we chose the labels for these profiles based on absolute values (cf., Wormington & Linnenbrink-Garcia, 2016). However, this labeling should not imply that

**Table 3**  
Entropy and goodness of fit for models representing 2 to 10 latent classes for motivation profiles (Sample 1 and Sample 2).

No. Classes	Entropy	LogL	SSA-BIC	$p$ LMR	$p$ PB
Sample 1					
2	.71	-16,875	33,806	<.001	<.001
3	.68	-16,332	32,742	<.001	<.001
4	.72	-16,102	32,303	<.001	<.001
5	.82	-15,905	31,931	<.001	<.001
6	.79	-15,783	31,710	.001	.001
7	.81	-15,646	31,460	.01	.01
8	.82	-15,573	31,335	.21	.22
9	.83	-15,507	31,225	.004	.005
10	.78	-15,449	31,132	.07	.08
Sample 2					
2	.67	-17,398	34,851	<.001	<.001
3	.67	-16,948	33,975	<.001	<.001
4	.69	-16,779	33,659	<.001	<.001
5	.82	-16,598	33,319	<.01	<.01
6	.80	-16,473	33,092	<.001	<.001
7	.81	-16,332	32,831	<.001	<.001
8	.82	-16,253	32,696	<.01	<.01
9	.78	-16,190	32,593	<.01	<.01
10	.79	-16,154	32,543	.35	.36

Note. LogLi = Loglikelihood value; SSA-BIC = sample-size-adjusted Bayesian information criterion;  $p$  LMR =  $p$  values for Lo-Mendell-Rubin adjusted likelihood ratio test;  $p$  PB =  $p$  values for Parametric bootstrapped likelihood ratio test. Entropy ranges from 0 to 1. Higher values indicate better classification utility. Smaller values for LogLi and SSA-BIC indicate better model fits. Ratio tests test models with  $k$  classes against models with  $k-1$  classes.

$N_{Sample 1} = 6,243/N_{Sample 2} = 6,415$



**Fig. 1.** Motivation profiles in Sample 1.

Motivation quantity is the mean score across the three motivation indicators. Note that this index has not been included in the latent profile analyses but is only shown here for illustration purposes.

motivation can be attributed only to individual characteristics, nor that motivation is necessarily a fixed variable.

**“Highly motivated”.** Students in this profile (13.2%,  $n = 825$ ) showed a high level of motivation across all motivation indicators in absolute terms. That is, they indicated a high general academic self-concept, a high school interest, and a high level of conscientiousness. In addition, for each motivation indicator, students in this profile showed the highest motivation level compared to all other profiles.

**“Conscientiously motivated”.** This profile contained more than half of all students (54%,  $n = 3,371$ ). Looking at the profile shape and keeping in mind that we were especially interested in the uncovering of potential compensatory processes, one could point out that conscientiousness was descriptively higher endorsed in this profile compared to school interest (with general academic self-concept lying in between). A paired samples  $t$ -test confirmed this difference to be statistically significant ( $t [3363] = -34.37, p < .001$ ) and large in size ( $d = 1.19$ ). We therefore termed this profile “Conscientiously motivated”, given that apart from the “Highly motivated” students, this profile was the only profile showing a score for conscientiousness above the samples’ average (see Table 2).

**“Unconfident”.** Students matching this profile were characterized by a relatively high level of conscientiousness and interest, but a relatively low academic self-concept, with a score lower than the samples’ average. Taking up this striking feature, we named this profile “Unconfident” students, which contained 14.6% of our sample (i.e.,  $n = 909$ ).

**“Self-confident”.** Students in this profile showed a similar motivation level compared to the “Unconfident” profile (see “Motivation quantity” index in Fig. 1). However, both profiles differed considerably in shape, given that students in the “Self-confident” profile indicated a relatively low level of interest and conscientiousness, but a relatively high level in terms of their general academic self-concept. In that, this profile is an almost perfect counterpart to the “Unconfident” profile. In total, 611 students (9.8%) were classified here, although it should be noted that this profile had the lowest average class assignment probability (see Table 4).

**“Lowly motivated”.** About 6.4% ( $n = 402$ ) of students showed a generally low motivation profile in terms of their general academic self-concept, school interest, and conscientiousness. However, in relation to students in the “Amotivated” profile (see below), the motivation level was not as low, but still well below the samples’ average and the theoretical scale midpoint.

**“Amotivated”.** Students in this profile were characterized by very low scores on each motivation indicator. To illustrate the difference

**Table 4**  
Means in general academic self-concept, general interest, and conscientiousness for the motivation profiles (Samples 1 and 2).

Motivation indicators	“Highly motivated” (1)	“Conscientiously motivated” (2)	“Unconfident” (3)	“Self-confident” (4)	“Lowly motivated” (5)	“Amotivated” (6)
Sample 1						
Self-concept	3.79 <sup>a</sup>	2.99 <sup>b</sup>	2.20 <sup>d</sup>	2.93 <sup>c</sup>	2.05 <sup>e</sup>	1.14 <sup>f</sup>
Interest	3.29 <sup>a</sup>	2.86 <sup>b</sup>	2.61 <sup>c</sup>	2.10 <sup>d</sup>	2.02 <sup>d</sup>	1.42 <sup>e</sup>
Conscientiousness	3.61 <sup>a</sup>	3.25 <sup>b</sup>	2.94 <sup>c</sup>	2.46 <sup>d</sup>	2.16 <sup>e</sup>	1.64 <sup>f</sup>
Sample 2						
Self-concept	3.79 <sup>a</sup>	2.99 <sup>b</sup>	2.20 <sup>d</sup>	2.94 <sup>c</sup>	2.05 <sup>e</sup>	1.23 <sup>f</sup>
Interest	3.31 <sup>a</sup>	2.91 <sup>b</sup>	2.61 <sup>c</sup>	2.09 <sup>d</sup>	2.02 <sup>d</sup>	1.69 <sup>e</sup>
Conscientiousness	3.59 <sup>a</sup>	3.24 <sup>b</sup>	2.97 <sup>c</sup>	2.43 <sup>d</sup>	2.19 <sup>e</sup>	1.89 <sup>f</sup>
Average class assignment probability Sample1/2	.89/.91	.93/.93	.83/.83	.63/.66	.72/.72	.93/.88

Note. Superscripts are presented in order from highest to lowest scores. Different superscripts indicate significantly different ( $p < .05$ ) means between profiles (i.e., per row), based on MANOVAs.

between these students and those in the “Lowly motivated” profile, we took reference to self-determination theory (e.g., Ryan & Deci, 2020), where *amotivation* is characterized as “a state in which people lack the intention to behave, and thus lack motivation as that term is defined in the cognitive-motivational tradition”; Deci & Ryan, 2000, p. 237). Typical motivation categories, thus, may not suffice to describe this profile. In absolute numbers, 125 of Luxembourgish 9th graders (about 2%) showed this profile, indicating a very low interest in schooling, a very low general academic self-concept, and very low level of conscientiousness.

#### 4.3. Motivation profiles and academic adjustment

##### 4.3.1. Test performance

Table 5 (upper part) displays comparisons between the different motivation profiles in regard to all indicators of academic adjustment. The Wald-test indicated an overall difference between motivation profiles for all four test performance scores including mean test performance (all  $\chi^2$  [5, all  $N > 5808$ ]  $> 102.29$ , all  $p < .001$ ). We refer to Cramér’s  $V$ , which is based on  $\chi^2$ , as effect size, where for  $df = 5$ , values above .04, .13, and .22 can be considered as small, medium, and large, respectively (Cohen, 1988). With Cramér’s  $V$  between .29 (Math) and .45 (mean test performance), profile differences were large for all achievement indicators. “Highly motivated” students performed better on all standardized tests than students from all other motivation profiles, except for Math and German, where they performed similarly compared to “Self-confident” students. “Conscientiously motivated” students performed either worse (i.e., test mean, Math, and German) or not substantially better (i.e., French test) compared to “Self-confident” students, yet still better than students in the “Amotivated”, “Lowly motivated”, and “Unconfident” profiles. However, compared to “Lowly motivated” students, the difference was not substantial with regard to Math. In addition, the comparison between “Unconfident” and “Self-confident” students revealed that the latter group clearly outperformed the former group in all domains. In fact, the “Unconfident” profile showed an even worse performance in the German and Math test compared to the “Lowly motivated” profile and did not differ substantially from “Amotivated” students with regard to the Math test. Finally, “Amotivated” students showed the poorest performance in both the German and French competency domains.

##### 4.3.2. School anxiety and satisfaction

Findings for academic well-being revealed somewhat different findings compared to students’ test performance (both  $\chi^2$  [5, all  $N > 6070$ ]  $> 248.36$ , both  $p < .001$ , Cramér’s  $V = .45$  and .62 for school anxiety and satisfaction, respectively). Particularly, “Unconfident” students indicated the highest anxiety towards schooling in general, despite their relatively high interest and conscientiousness, and “Conscientiously motivated” students were more anxious compared to “Highly motivated”, “Lowly motivated”, and “Amotivated” students. In addition,

anxiety levels in the “Amotivated” profile did not differ significantly from those in the “Highly motivated” and “Self-confident” profile.

In terms of satisfaction with school, “Self-confident” students reported to be less satisfied with their respective school compared to “Unconfident” students and showed a similar low satisfaction compared to “Lowly motivated” students. In addition, despite their relatively high school anxiety, “Conscientiously motivated” students reported a relatively high school satisfaction. Finally, “Highly motivated” students reported the highest and “Amotivated” students the lowest school satisfaction.

##### 4.3.3. Motivation profiles and background variables

With regard to gender, the R3STEP approach revealed several significant relationships with the motivation profiles (see Table 6). We concentrate our description on Odds Ratios that reflect at least a small effect, that is, ORs  $> 1.68$  and  $< 0.60$  (Chen, Cohen, & Chen, 2010). Male students were more likely to be assigned to the “Self-confident” than to the “Highly motivated”, “Conscientiously motivated”, “Unconfident”, or the “Amotivated” profiles. Male students were also more likely “Lowly motivated” than “Highly motivated”, “Unconfident”, or “Conscientiously motivated”. Lastly males were more likely to be “Amotivated” than “Unconfident”.

Regarding school track, we found that students in the highest school track were more likely “Highly motivated” or “Conscientiously motivated” than “Unconfident” or “Amotivated”. They were also more likely “Self-confident” than “Unconfident”, “Lowly motivated” or “Amotivated”, more likely “Lowly motivated” than “Unconfident”, and less likely “Lowly motivated” than “Amotivated”. For students in the middle track, we found that students were more likely “Highly motivated”, “Conscientiously motivated”, “Unconfident”, or “Self-confident” than “Amotivated”, but more likely “Amotivated” than “Lowly motivated”.

## 5. Results Sample 2 (“Replication and extension”)

With the second sample, we sought to substantiate our findings in two ways. First, we wanted to replicate the motivational profiles found in Sample 1. This seemed particularly relevant regarding the “Amotivated” profile, which depicted only a small group of Luxembourgish 9th graders. Hence, its replication in another cohort would speak for its meaningful substance rather than being a methodological artefact. In addition, our interpretation of the “Conscientiously motivated” profile—and its potential to verify a compensatory effect of conscientiousness over interest—would profit from a replication, given that the profile was not as pronounced as suggested by the CONIC model (e.g., Trautwein et al., 2015). Second, with Sample 2, we took the opportunity to learn more about the assumed predictive validity of different motivation profiles on academic achievement above and beyond students’ prior academic achievement. To do so, we controlled students’ prior grades when using the BCH method to regress students’ current grades on motivation profiles.



**Table 5**  
Standardized (and Adjusted) Means for Academic Adjustment for the six Latent Profiles (Samples 1 and 2).

	Motivation profiles						Profile comparisons (mean differences)														
	Sample 1						Sample 2														
	HM (1)	CM (2)	UC (3)	SC (4)	LM (5)	AM (6)	1-2	1-3	1-4	1-5	1-6	2-3	2-4	2-5	2-6	3-4	3-5	3-6	4-5	4-6	5-6
German test	0.39	0.02	-0.42	0.22	-0.20	-0.65	0.37	0.81	0.17	0.59	1.04	0.44	-0.20	0.22	0.67	-0.64	-0.22	0.23	0.42	0.87	0.45
French test	0.28	0.01	-0.32	-0.03	-0.25	-0.60	0.27	0.60	0.31	0.53	0.88	0.33	0.04	0.26	0.61	-0.29	-0.07	0.28	0.22	0.57	0.35
Math test	0.32	0.01	-0.41	0.27	-0.11	-0.63	0.31	0.73	0.05	0.43	0.95	0.42	-0.26	0.12	0.64	-0.68	-0.30	0.22	0.38	0.90	0.52
Test mean	0.31	0.03	-0.38	0.15	-0.19	-0.63	0.28	0.69	0.16	0.50	0.94	0.41	-0.12	0.22	0.66	-0.53	-0.19	0.25	0.34	0.78	0.44
Anxiety	-0.31	0.10	0.51	-0.54	-0.09	-0.55	-0.41	-0.82	0.23	-0.22	0.24	-0.41	0.64	0.19	0.65	1.05	0.60	1.06	-0.45	0.01	0.46
Satisfaction	0.39	0.18	-0.10	-0.55	-0.68	-1.08	0.21	0.49	0.94	1.07	1.47	0.28	0.73	0.86	1.26	0.45	0.58	0.98	0.13	0.53	0.40
Sample 2																					
German test	0.42	0.04	-0.40	0.07	-0.18	-0.69	0.38	0.82	0.35	0.60	1.11	0.44	-0.03	0.22	0.73	-0.47	-0.22	0.29	0.25	0.76	0.51
French test	0.23	0.07	-0.25	0.04	-0.23	-0.66	0.16	0.48	0.19	0.46	0.89	0.32	0.03	0.30	0.73	-0.29	-0.02	0.41	0.27	0.70	0.43
Math test	0.27	0.01	-0.33	0.27	-0.16	-0.55	0.26	0.60	0.00	0.43	0.82	0.34	-0.26	0.17	0.56	-0.60	-0.17	0.22	0.43	0.82	0.39
Test mean	0.29	0.04	-0.33	0.13	-0.19	-0.63	0.25	0.62	0.16	0.48	0.92	0.37	-0.09	0.23	0.67	-0.46	-0.14	0.30	0.32	0.76	0.44
Anxiety	-0.30	0.07	0.50	-0.51	-0.18	-0.61	-0.36	-0.80	0.22	-0.12	0.26	-0.44	0.58	0.24	0.10	1.02	0.68	0.54	-0.34	-0.48	-0.14
Satisfaction	0.40	0.19	-0.15	-0.56	-0.64	-0.94	0.23	0.56	0.97	1.05	1.34	0.33	0.74	0.82	1.11	0.41	0.49	0.78	0.08	0.37	0.29
Grades <sup>a</sup>																					
German	0.36	0.11	-0.27	0.01	-0.20	-0.45	0.25	0.63	0.35	0.56	0.81	0.38	0.10	0.31	0.56	-0.28	-0.07	0.18	0.21	0.46	0.25
French	0.26	0.24	0.17	0.10	-0.36	-0.07	0.02	0.09	0.16	0.62	0.33	0.07	0.14	0.60	0.31	0.07	0.53	0.24	0.46	0.17	-0.29
Math	0.52	0.01	-0.17	-0.23	-0.53	-0.52	0.51	0.69	0.75	1.05	1.04	0.18	0.24	0.54	0.53	0.06	0.36	0.35	0.30	0.29	-0.01
Grade mean	0.36	0.14	-0.09	-0.05	-0.43	-0.43	0.22	0.45	0.41	0.87	0.79	0.23	0.19	0.65	0.57	-0.04	0.42	0.34	0.46	0.38	-0.08

Note. HM = "Highly motivated", CM = "Conscientiously motivated", UC = "Unconfident", SC = "Self-confident", LM = "Lowly motivated", AM = "Amotivated". Continuous variables were standardized beforehand and differences can thus be interpreted in the same manner as Cohen's *d*.  
<sup>a</sup>Adjusted means for grades in class 9 (i.e., 2020) controlled for the respective grade in class 8 (i.e., 2019), gender, and school track. Effect sizes displayed in bold are significant at  $p < .001$ . Effect sizes displayed in bold italics are significant at  $p < .01$ . Effect sizes displayed in italics are significant at  $p < .05$ .

5.1. Preliminary descriptive and bivariate analyses

As can be seen in Table 2, mean scores and bivariate correlations were similar compared to Sample 1. In both years, students' grades in German, French, and Math yielded a positive correlation to all three motivation indicators, students' competencies (i.e., ÉpStan scores) and school satisfaction. More specifically, results indicated somewhat lower associations between grades and general interest, somewhat higher associations with motivation when considering the grades' mean, and especially pronounced associations between grades and standardized test scores when considering the same subject domain and mean scores, respectively. In addition, we observed a small negative correlation to school anxiety, except for French grades, where both bivariate correlations had a positive sign.

5.2. Motivation profiles

Table 3 (lower part) displays the fit parameter and entropy values for models between two to 10 latent classes in the 2019 sample. Again, the SSA-BIC parameter, elbow plots, and the PB test were of little informative value, whereas entropy values were higher for models with five or more motivation profiles. The LMR test favored models with nine or less latent classes, but for models with seven or more classes, two or more small groups were extracted. Therefore, we again focused on the two models with five and six latent classes.

As in Sample 1, findings from the 2019 cohort were of greater theoretical meaning in the 6-class compared to the 5-class solution. Most importantly, the 6-class solution revealed almost identical motivation profiles as we found in Sample 1.

As can be seen from Fig. 2, the extracted profiles matched the "Highly motivated" (14.2%;  $n = 910$ ), "Conscientiously motivated" (52.1%;  $n = 3,344$ ) "Unconfident" (15.6%;  $n = 999$ ), "Self-confident" (9.6%;  $n = 616$ ), "Lowly motivated" (6.6%;  $n = 426$ ), and "Amotivated" (1.9%;  $n = 120$ ) profiles from Sample 1. The only noteworthy difference was that "Amotivated" students' scores for the three motivation indicators were not as low as in the 2018 cohort. In "Conscientiously motivated" students, conscientiousness was again expressed to a considerable higher degree than interest in schooling,  $t(3363) = -29.85, p < .001, d = 1.03$ .

5.3. Motivation profiles and academic adjustment

5.3.1. Test performance

As can be seen from the lower part of Table 5, findings generally replicated those from Sample 1 (all  $\chi^2 [5, \text{all } N > 5946] > 103.42, \text{all } p < .001$ , Cramér's *V* between .28 [French test] and .41 [mean test performance]). "Highly motivated" students outperformed all other motivation profiles on all standardized tests, except for "Self-confident" students, who showed a similar math performance. "Conscientiously motivated" students, again performed either worse (i.e., Math tests) or not substantially better (i.e., German and French tests) than "Self-confident" students, yet still better than students in the "Unconfident", "Lowly motivated", and "Amotivated" profiles. In addition, "Self-confident" students again clearly outperformed "Unconfident" students in all domains, and the latter profile showed a similar poor performance compared to "Lowly motivated" students in French and Math. In addition, "Unconfident" students did not differ significantly from "Amotivated" students in Math.

5.3.2. School anxiety and satisfaction

As in Sample 1, motivation profiles covaried meaningfully with school anxiety and satisfaction (both  $\chi^2 [5, \text{all } N > 6340] > 341.74, \text{both } p < .001, \text{Cramér's } V = .52 \text{ for both}$ ). A notable difference to Sample 1 was that "Amotivated" students in Sample 2 showed a somewhat higher level of school anxiety. Therefore, this profile did not differ from "Conscientiously motivated" and "Lowly motivated" students in terms of

**Table 6**  
Background variables predicting membership to latent motivation profiles (Samples 1 and 2).

Predictor	CM vs. HM			UC vs. HM			SC vs. HM			LM vs. UC			AM vs. HM								
	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE	Est.	OR	SE						
Gender (male = 1)	Sample 1	-0.12	0.88	0.06	0.46	0.05	<.001	1.31	3.70	0.74	<.001	0.81	2.24	0.30	<.001	0.34	1.41	0.31	0.179		
	Sample 2	-0.03	0.96	0.07	.659	0.11	.026	1.25	3.49	0.59	<.001	0.78	2.18	0.32	<.001	0.31	1.35	0.37	.347		
School track (Highest = 1)	Sample 1	-0.10	0.90	0.21	.639	0.10	<.001	0.20	1.23	0.34	.503	-0.46	0.64	0.21	.082	-1.83	0.16	0.08	<.001		
	Sample 2	-0.12	0.89	0.17	.512	0.09	<.001	0.04	1.04	0.27	.879	-0.32	0.72	0.19	.144	-1.14	0.32	0.15	<.001		
School track (Middle = 1)	Sample 1	0.25	1.28	0.29	.342	0.21	.370	0.15	1.16	0.30	.604	-0.12	0.89	0.26	.659	-0.93	0.40	0.17	<.001		
	Sample 2	0.29	1.33	0.26	.209	0.20	.999	0.03	1.03	0.26	.899	-0.06	0.95	0.24	.820	-0.03	0.97	0.29	.924		
		UC vs. CM			SC vs. CM			LM vs. UC			AM vs. CM			SC vs. UC							
Gender (male = 1)	Sample 1	-0.28	0.76	0.06	<.001	1.43	4.19	0.85	<.001	0.93	2.53	0.34	<.001	0.47	1.60	0.31	.051	5.52	1.00	<.001	
	Sample 2	-0.24	0.78	0.07	.003	1.28	3.61	0.51	<.001	0.81	2.25	0.36	<.001	0.33	1.40	0.38	.291	1.53	4.61	0.78	<.001
School track (Highest = 1)	Sample 1	-1.04	0.35	0.08	<.001	0.31	1.36	0.37	.334	-0.35	0.70	0.17	.079	-1.73	0.18	0.06	<.001	1.34	3.83	1.11	.011
	Sample 2	-0.84	0.43	0.06	<.001	0.16	1.17	0.24	.481	-0.21	0.82	0.18	.293	-1.03	0.36	0.19	.001	1.00	2.72	0.60	.004
School track (Middle = 1)	Sample 1	-0.46	0.63	0.12	.001	-0.10	0.90	0.28	.732	-0.37	0.69	0.17	.065	-1.17	0.31	0.10	<.001	0.36	1.43	0.43	.324
	Sample 2	-0.29	0.75	0.09	.006	-0.25	0.78	0.15	.144	-0.34	0.71	0.12	.015	-0.31	0.73	0.26	.292	0.03	1.03	0.19	.865
		LM vs. UC			AM vs. UC			LM vs. SC			AM vs. SC			LM vs. AM							
Gender (male = 1)	Sample 1	1.21	3.34	0.51	<.001	0.74	2.10	0.41	.007	-0.50	0.61	0.13	.002	-0.97	0.38	0.09	<.001	-0.46	0.63	0.15	.012
	Sample 2	1.06	2.87	0.66	.004	0.58	1.78	0.50	.118	-0.47	0.64	0.12	.002	-0.95	0.28	0.04	<.001	-0.48	0.62	0.19	.049
School track (Highest = 1)	Sample 1	0.69	1.98	0.69	.153	-0.69	0.50	0.22	.023	-0.66	0.52	0.18	.006	-2.04	0.13	0.06	<.001	-1.38	0.25	0.09	<.001
	Sample 2	0.64	1.89	0.47	.058	-0.18	0.83	0.46	.718	-0.36	0.70	0.17	.077	-1.18	0.85	0.18	.409	-0.82	0.44	0.24	.018
School track (Middle = 1)	Sample 1	0.09	1.09	0.38	.802	-0.71	0.49	0.18	.004	-0.27	0.77	0.28	.407	-1.07	0.34	0.14	<.001	-0.81	0.45	0.15	<.001
	Sample 2	0.06	0.95	0.16	.733	-0.03	0.97	0.35	.939	-0.09	0.92	0.19	.655	-0.06	1.29	0.26	.257	0.03	1.03	0.42	.948

Note. HM = "Highly motivated", CM = "Conscientiously motivated", UC = "Unconfident", SC = "Self-confident", LM = "Lowly motivated", AM = "Amotivated". OR = Odds ratio. ORs > 1.68 and < 0.60 are displayed in bold.

their anxiety. Furthermore, "Unconfident" students indicated again the highest anxiety towards schooling. In terms of satisfaction with school, "Self-confident" students again reported to be less satisfied with their respective school compared to "Unconfident" and also "Conscientiously motivated" students, and at a similar level compared to "Lowly motivated" students.

5.3.3. Prediction of grades

To lend somewhat more credence to the assumption that motivation profiles determine academic achievement, we regressed grades at the end of class 9 (i.e., academic year 2019/2020) on previously measured motivation, while controlling for the respective grades in class 8 (i.e., academic year 2018/2019), as well as for gender and school track as relevant background variables (cf., Duckworth & Seligman, 2006; Gasparid et al., 2019). To do so, we applied a manual R3STEP procedure as described in Asparouhov and Muthén (2014b).

As displayed in Table 5 (lower part), motivation profiles covaried substantially with class 9 grades after controlling for previous grades, gender, and school track (all  $\chi^2$  [5, all  $N > 3911$ ] > 26.39, all  $p < .001$ ). Cramér's V indicated a large effect for German (.32), mean grade (.27), and Math (.24) and a medium-sized effect for French (.18). Compared to "Lowly motivated" students, "Highly motivated", "Conscientiously motivated", "Self-confident", and "Unconfident" students received better grades in French. In German and Math, "Highly motivated" students outperformed students from all other motivation profiles, whereby effect sizes seemed a bit higher for Math. In addition, "Conscientiously motivated" students received better grades in all subjects compared to "Lowly motivated" students and better grades than "Amotivated" students in German. The pattern for students' mean grade was very similar to the one for Math, with the only difference that both students in the "Unconfident" and "Self-confident" profile outperformed students in the "Lowly motivated" profile.

5.3.4. Motivation profiles and background variables

When we used gender and school track to predict motivation profiles, findings from Sample 1 were largely replicated (see Table 6 and Appendix A). For example, male students again were characterized as particularly "Self-confident" (in comparison to all other motivation profiles), but also rather "Lowly motivated" (in comparison to four other motivation profiles). By contrast, female students were more often "Unconfident". Regarding school track, motivation patterns for the highest track reflected again that students were more "Highly" or "Conscientiously" motivated than "Unconfident" and "Amotivated", more "Self-confident" and "Lowly motivated" than "Unconfident", and more "Amotivated" than "Lowly motivated". However, they were not more "Self-confident" than "Lowly motivated" or "Amotivated", as found in Sample 1. For the middle track, results did not indicate any effect at least small in size (Chen et al., 2010). However, descriptively, it stood out that this track was overrepresented in the "Amotivated" profile in this cohort.

6. General discussion

Giving the lack of research addressing interactive processes among expectancy, value, and conscientiousness in a single analysis, we applied a typological approach in search for motivation profiles that are informative in relation to students' academic adjustment. Previous variable- and person-oriented studies in this domain either applied additive models (e.g., Grund & Senker, 2018; Steinmayr et al., 2018) or concentrated on configurations of only two out of these three motivation categories (e.g., Guo et al., 2015; Meyer et al., 2019; Nagengast et al., 2011; Rieger et al., 2022; Trautwein et al., 2012). Yet, as has been argued (e.g., Lee, Friedman, et al., 2022; Linnenbrink-Garcia et al., 2018; Perez et al., 2019), person-oriented approaches seem ideally suited to capture the phenomenological richness of academic motivation and to seek integration across a large array of motivational concepts,

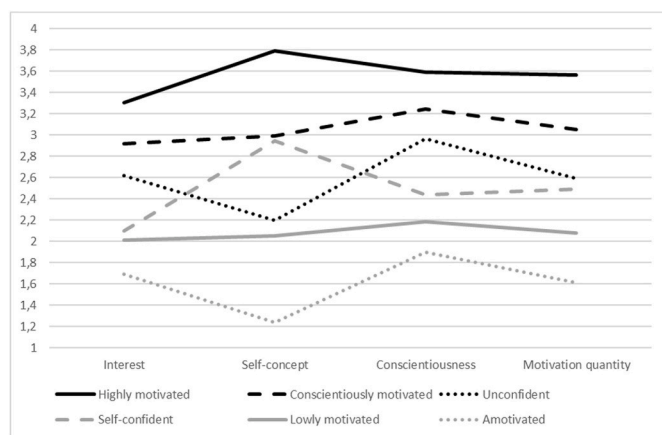


Fig. 2. Motivation profiles in Sample 2.

Motivation quantity is the mean score across the three motivation indicators. Note that this index has not been included in the latent profile analyses but is only shown here for illustration purposes.

thereby helping to get a comprehensive and detailed picture on how academic motivation looks and how it works in situ (Wormington & Linnenbrink-Garcia, 2016).

In this regard, we were able to identify and replicate at least three motivation profiles where the relative configuration of the three motivation indicators, that is, profile shape, seemed to be as important, if not more important, as compared to their shared intensity, that is, profile level. First and foremost, students' general academic self-concept seemed to play a primary role in profile composition, characterizing two profiles where either a relatively high academic self-concept is paired with relatively low school interest and conscientiousness (i.e., "Self-confident" students), or vice versa (i.e., "Unconfident" students). Notably, these two profiles, both representing a fairly substantial amount of 9th grade students (i.e., about 10 and 15%, respectively), differed not particularly in *how much* students were motivated in total, but rather in *which* motivation parameter(s) dominated over the other (s). The third profile worth to point out in this regard are "Conscientiously motivated" students, reflecting a relatively high level of motivation across all motivation parameters, but with students' conscientiousness exceeding their general academic self-concept and especially their general interest in schooling in relative terms. In a way, this profile characterizes the "typical" 9th grade student, as more than half of the students fitted this profile in both samples.

Notably, relating these profiles to different indicators of academic adjustment pointed to compensatory and interference effects of specific combinations of academic self-concept, interest, and conscientiousness, while the remaining three profiles, that is, "Highly motivated", "Low motivated", and "Amotivated" students, mainly pointed to synergistic effects among these motivation indicators.

## 6.1. Conceptual implications

### 6.1.1. Multiplicative processes between expectancy and value

Expectancy-value theory (e.g., Eccles & Wigfield, 2002, 2020) proposes that believing in one's capabilities and valuing a task- or school-related outcome go hand in hand, and interact in predicting academic adjustment (Gaspard et al., 2019; Nagengast et al., 2011). According to this view, only when both expectancies and values are high, we can expect a high resulting motivation that supports academic adjustment. This *synergistic* assumption was partially supported by our findings. For almost a quarter of 9th graders in our samples, profiles that mainly differed in the overall level of motivation indicators but showed no distinctive shape (i.e., "Highly motivated", "Lowly motivated", and "Amotivated" students), the co-existence of either high, low, or very low

expectancy and value beliefs (as well as conscientiousness) went together with either good, poor, or bad academic adjustment, respectively. That is, for some 22% (Sample 1) or 23% (Sample 2) of students in our samples, synergistic processes between the three motivation indicators may have contributed to an either positive or negative motivation spiral, which in turn may have affected academic achievement. In addition, for "Unconfident" students, the non-compensatory, synergistic model seems to fit the present data well, as they showed a rather poor academic adjustment linked to a low school self-concept alone, despite indicating a relatively high interest (and conscientiousness).

However, low expectancy beliefs, as expressed in the "Unconfident" profile, seem particularly problematic, as an *interference* process appears to be at work here. It is not just that students with reasonable interest in schooling (and reasonable conscientiousness) do not profit from a synergistic boost in motivation when they do not believe in their school-related abilities. Rather, they seem to have developed even lower basic competencies and report more school anxiety compared to students who indicate low motivation across all three motivation indicators (i.e., "Lowly motivated" profile). Thereby, findings for "Unconfident" students match the variable-oriented findings by Trautwein et al. (2012) as well as Meyer et al. (2019). Although the picture was somewhat different regarding school satisfaction, where "Unconfident" students reported to be more satisfied with their school than their "Self-confident" peers, future research should nevertheless consider such motivational constellations that are not in line with the idea of a general reciprocal process between expectancy and value (Wigfield et al., 1997).

While expectancy beliefs seem to be a necessary requirement for motivation, the same does not seem to be true for value beliefs (i.e., interest in schooling). Notably, lacking interest (and conscientiousness) does not really seem to be a big issue for roughly 10 percent of 9th grade students (i.e., "Self-confident" students), when *compensated* by a relatively high belief in school-related capabilities (i.e., general school self-concept), at least in terms of test performance and school anxiety. Hence, for those students, "just believing in themselves" may not only be a necessary but in fact a *sufficient* requirement to be or become "motivated", which clearly stands in contrast to the assumption of synergistic motivation processes (Nagengast et al., 2011). Expectancy-value theory takes credit for the primary role of expectancy in comparison to value in so far as the former may be seen more a precursor of the latter rather than the other way around (Denissen et al., 2007; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). However, the reciprocal relationship between the two concepts, eventually, should also lead to the development of value beliefs, which does not seem to be the case in "Self-confident" students.

What then is so special about these students, given that they showed, for example, a similar low school anxiety as "Amotivated" students and a similar low school satisfaction as "Low motivated" students, but performed considerably better in the competency tests compared to both other profiles? In a way, it seems as if these students do not care so much about schooling itself (i.e., low interest and anxiety) and complying with social norms (i.e., low conscientiousness), but they seem to progress through education, because they know that they can handle the challenges they (will) face. Where this confidence comes from is an open question. Seemingly, students can be "Self-confident" across school tracks and therefore potentially also across socio-economic statuses (cf., Fischbach et al., 2014). However, one thing that strikes is the fact that these students possess quite good basic competencies, especially in Math, and they seem to be aware of this fact. Furthermore, as shown in Sample 2, their objective Math competencies, as indicated by standardized test scores, is not reflected by teachers' ratings, as "Self-confident" students received relatively poor grades in Math. This mismatch may partially explain why these students see no value in schooling itself and why they report relatively low school satisfaction. Compared to "Low motivated" students, one could also speculate that "Self-confident" students show what organizational psychologist call a *constructive dissatisfaction* (Kovacs, Stiglbauer, Batinic, & Gnams,

2018). Constructive dissatisfaction results when individuals (i.e., students) have higher aspirations than the contexts they belong to (i.e., schools or school tracks) can satisfy. When students maintain their high academic aspiration *and* try to close the gap by addressing the problem with a solution-oriented mindset, this can be quite productive, although they still would report to be rather unsatisfied. Future research should further secure and explore this unexpected type of motivation. For example, it is of course possible that these students see instrumental value in schooling (cf., Eccles & Wigfield, 1995), a value aspect not regarded in the present study.

### 6.1.2. Compensatory processes of conscientiousness

According to the CONIC model (Rieger et al., 2022; Song et al., 2020; Trautwein et al., 2015), high conscientiousness can compensate for low academic interest, thereby securing academic engagement and achievement via self-discipline, an idea that also resonates in self-control research (Duckworth et al., 2019; Duckworth & Seligman, 2005). In the present study, we did not find such a pronounced combination of low intrinsic value (i.e., general school interest) and high conscientiousness. However, “Conscientiously motivated” students, reported to be more conscientious than interested in schooling on a rather high general level of motivation (with their general school self-concept lying in between the other two variables). Therefore, this group may be carefully interpreted in line with previous variable-oriented research on the compensatory role of conscientiousness (Di Domenico & Fournier, 2015; Rieger et al., 2022; Song et al., 2020; Trautwein et al., 2015), while acknowledging that (a) the difference between conscientiousness and interest descriptively was rather small (despite yielding a large effect) and (b) the absolute level of interest was still relatively high.

Indeed, students in this profile reported to be relatively satisfied with schooling and also received relatively good grades. However, given a lack of motivation profiles that share a similar “quantity-of-motivation” level but show a different shape compared to “Conscientiously motivated” students, it is not clear whether this effect should be attributed to the profiles specific shape or its relatively high motivation level. Note however, that “Self-confident” students showed a comparable if not higher academic achievement, particularly in terms of standardized test scores, without being either high in conscientiousness *or* interest. That is, compared to “Self-confident” students, “Conscientiously motivated” students seem to invest much more, without showing a tangible benefit.

Further support for a potential special functional role of conscientiousness in motivated behavior comes from its relation to school anxiety. There seems to be a qualitative difference between “Highly motivated” and “Conscientiously motivated” students, given that the latter profile shows the second “best” motivation in terms of motivation level, but shows considerably higher anxiety compared to the former profile and to other motivation profiles indicative of a lower motivation level. These findings support the notion that shape differences in motivation profiles can be meaningful, even though there are no pronounced level differences. They also highlight that the “Conscientiously motivated” profile seems to go along with maladaptive aspects of academic adjustment as well, as this group of students showed a relatively high school anxiety, even higher than “Lowly motivated” students, thereby substantiating the suggestion that learning driven by conscientiousness compared to learning out of interest has a very different “feel” (Trautwein et al., 2015).

The emotional cost of acting ego-involved (cf. Deci & Ryan, 2000) or self-controlled is typically referred to as “ego-depletion” (Muraven & Baumeister, 2000) or “alienation” (Kuhl & Kazén, 1994), meaning that certain motivational-emotional resources are drained and access to self-defining core features of the organism eventually may get lost when acting in this mode for a long time. So, although we may have been successful in demonstrating a small compensatory process for “Conscientiously motivated” students, particularly with regard to school satisfaction and grades, future research should consider the potential downsides of this motivation profile, especially because the majority of

students seems to function in this specific way. In addition, it is worth to note that given that no future-directed value aspects (e.g., utility and attainment value, cf., Eccles & Wigfield, 2002) have been addressed in our study, we cannot say for sure that “being conscientiously motivated” is much different from “being extrinsically” motivated (Costantini et al., 2020).

Finally, it is important to note that in “Unconfident” students, relatively high conscientiousness could *not* compensate for a low academic self-concept. Quite on the contrary, trying to “push hard” while at the same time not believing in oneself may have contributed to accumulating especially high emotional costs (i.e., the highest school anxiety among all profiles; see also Meyer et al., 2019).

### 6.1.3. Motivational profiles and background variables

Adopting a typological approach seems particularly fruitful to seek theoretical integration and to capture the richness and functioning of motivation in all its naturally existing shades and facets (cf., Linnenbrink-Garcia et al., 2018; Pintrich, 2003). However, by placing the student (or rather certain groups of students) in focus, this approach also carries the risk to give the impression that motivation is solely a characteristic of the individual, while many theories stress the importance of contextual features, such as school settings and transmitted social roles in shaping motivation (e.g., Eccles & Wigfield, 2002; Reeve, Deci, & Ryan, 2004; Ryan & Deci, 2020).

Although it was not our focal goal, we tried to acknowledge this contextualization of motivation by relating existing motivation profiles to background variables such as students’ gender and the respective school track students attended (cf., Eccles et al., 1993; Fong et al., 2021; Gaspard et al., 2019; Hsieh et al., 2021; Lazarides et al., 2021). Findings indicate that male and female students do not only differ in their domain-specific expectancies and values (e.g., Gaspard et al., 2019; Lazarides et al., 2021), but also in their general academic self-concept and their motivation level. Male students, overall, were markedly overrepresented in the “Self-confident”, “Lowly motivated”, and “Amotivated” profiles, whereas female students were slightly overrepresented in the “Unconfident” profile (see also Appendix A for more descriptive information). Regarding school track, patterns were less obvious, as we found, for example, “Conscientiously motivated”, “Self-confident”, and “Lowly motivated” students to be relatively equally distributed across all tracks. Yet, students in the highest track seemed slightly overrepresented in the “Highly motivated” profile and underrepresented in the “Unconfident” and “Amotivated” profile. In addition, students in the “Amotivated” profile were overrepresented in the lowest track.

## 6.2. Practical implications

### 6.2.1. How are students motivated?

The first and primary practical implication we see is that our approach provides a differentiated picture on how motivation typically unfolds in schools. Previous variable-oriented approaches addressing academic motivation conveyed the rather dystopic picture of decreasing expectancy and value beliefs with increasing duration of schooling (cf., Scherrer & Preckel, 2019), and when acknowledging multiplicative processes among these two motivation categories, they failed to provide a conclusive idea on the practical relevance of certain motivational constellations (see Perez et al., 2019; Trautwein et al., 2012). In addition, previous person-oriented studies were typically carried-out within a single theoretical perspective, either focusing on specific expectancies or values (e.g., Marsh et al., 2009; Vansteenkiste et al., 2009) or neglecting conscientiousness (e.g., Fong et al., 2021; Gaspard et al., 2019; Hsieh et al., 2021; Linnenbrink-Garcia et al., 2018).

Addressing this gap, our work shows that up to one quarter of Luxembourgish 9th graders may indeed require further attention, as they were assigned to the “Amotivated”, “Lowly motivated”, or “Unconfident” motivation profile. This special need is not only reflected in low

test scores and grades found for these three profiles, but also in terms of students relatively high school anxiety and relatively low satisfaction with school. The good news then is, however, that three quarters of 9th graders may be seen to show more adaptive motivation patterns.

From this perspective, the “motivation problem” in schooling may not be as extensive as sometimes insinuated. Not least, our typological approach provides clear numbers that may be easier to interpret compared to average scale values on different motivation parameters (which require a certain standard against which a given value can be compared), or compared to interaction terms (Perez et al., 2019). Our approach goes even further by describing qualitative different types of student motivation, some of which may raise concerns, not because of a low motivation level, but because of a distinct profile shape. Notably, “Unconfident” students may be at risk in school not because they show no motivation at all; rather the critical aspect of this profile is reflected in a relatively low academic self-concept in particular, as well as in low competencies acquired and a high anxiety developed with regard to schooling in general.

In this sense, we can also question in how far the “Conscientiously motivated” and “Self-confident” profile can be considered as reflecting “good” motivation. Particularly the “Conscientiously motivated” student group requires further attention. Can educators be happy with the majority of students being reasonably motivated for and satisfied with schooling, receiving reasonable grades, but experiencing a relatively high school anxiety? Clearly, this mindset has a certain drawback.

### 6.2.2. Tailored interventions

A detailed description of different forms of academic motivation, paired with a solid understanding of the specific involved processes, can be used to develop interventions, tailored to the specific motivational problem. Motivation research has a long, rich, and ongoing tradition in the development of theory-based interventions, especially focusing on school contexts (e.g., Anderman, 2021; DeCharms, 1976; McClelland & Winter 1969; Reeve et al., 2004; Rheinberg & Krug, 2017). However, as argued by Hulleman and Barron (2016), interventions should also address real-world problems. Yet, these problems may differ between students, related to differences in their motivation profiles.

With regard to “Amotivated” students, given the severity of their apparent academic refusal and failure, probably no existing motivation intervention alone may be effective. Rather, this small group of students may profit only from an in-depth socio-educational program, focusing on school-related issues as well as other social issues (Reid, 2000). In terms of content validity, it should therefore be considered that this profile probably does not only capture very low motivation towards schooling, but a more general disapproval of certain social norms, which could also be reflected in a rather low compliance with the ÉpStan protocol.

By contrast, “Lowly motivated” students may profit from any kind of effective motivation intervention, given a lack of both expectancy and value beliefs, and assuming reciprocal relationships between expectancy and value (e.g., Denissen et al., 2007). Therefore, multicomponent programs, addressing several motivation categories, potential supplemented by a focus on a specific curricula content and educational practices (Guthrie, Wigfield, & VonSecker, 2000; Martin, 2008), seem to be the most adequate support for these students. Alternatively, interventions could start by focusing on strengthening value beliefs (e.g., Harackiewicz et al., 2014), in the hope that students will also become more confident in their school-related capabilities (Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009).

For “Unconfident” students, the value enhancement approach may not be as effective, given that they seem to be generally interested in schooling, which for itself, is quite a favorable situation (cf., Sansone & Harackiewicz, 2000; Schiefele, 2009). Rather, their low general academic self-concept seems to be the central problem, and therefore, requires specific attention. Unfortunately, compared to value interventions, specific expectancy interventions seem to be an

understudied topic, especially within the expectancy-value framework (Eccles & Wigfield, 2020; Lazowski & Hulleman, 2016). Maybe this is because underestimating one’s potential and capability to solve everyday challenges often roots in deep dysfunctional cognitive patterns that may not be easily addressed by reminding (predominately female) students that they “just” need to believe in themselves. Therefore, more indirect approaches, focusing on realistic goal setting and functional attributions for success and failure should be considered here (Anderman, 2021; Hall et al., 2007; Hamm et al., 2020; Heckhausen, 1975).

Finally, for “Conscientiously motivated” students, focusing more on the learning task itself, the progress they make, and the direct gratification provided by mastering challenging task independently, rather than on the socially meaningful outcomes of learning could be a promising approach, in line with well-established self-determination theory (Ryan & Deci, 2020) and the concept of temporal reference norm orientation (Dickhäuser, Janke, Praetorius, & Dresel, 2017).

### 6.3. Strength and weaknesses

We see the strength of our research in its differentiated and integrative view on motivation. Differentiated means that we applied an in-depth analysis on academic motivation by addressing both quantitative and qualitative aspects of motivation. It also means that we acknowledged a rather broad spectrum of possible indicators for academic adjustment. Integrative means that we tried to bring together three different motivational concepts that are typically studied separately or only in an additive way: expectancy (i.e., academic self-concept), value (academic interest), and conscientiousness.

In terms of the substance of the six motivation profiles we identified, we deem it a strength that findings from both samples showed a clear convergence. Not only did we replicate all six profiles, both in terms of their nature and prevalence; these profiles also showed similar relationships with regard to academic adjustment and background variables in both samples. A small inconsistency could be noted in terms of the severity of the “Amotivated” student profile, which was more negatively pronounced in Sample 1 compared to Sample 2. This may explain, why some of the substantial patterns we found in Sample 1 for the middle school track did not replicate in Sample 2. It is also worth to note that the samples we used can be regarded as representative for Luxembourgish 9th grade students. Although Luxembourgish students perform rather low in international comparisons (OECD, 2019), we see no reason why similar profiles should not be found in other (Western) populations. Yet, recent findings on the concept of school alienation let suggest that the “Amotivated” profile may be of particular relevance for the highly-stratified Luxembourgish education system (Hadjar et al., 2021). Hence, it would be worth to apply a similar rationale to different populations, to enlarge the generalizability of our findings.

A striking feature lies in the high abstraction level of our approach. In line with conscientiousness being considered a general characteristic of a person, we applied a similar general understanding of expectancy and value components. That is, we relied on students’ general interest towards schooling and their general academic self-concept. There is, however, an extensive literature showing that students tend to very finely differentiate between different school subjects when it comes to their attributed expectancies and values (e.g., Eccles & Wigfield, 2020; Marsh et al., 2009). That is, the profiles we found may differ when motivational judgements are referred to a specific school subject, for example. This may be especially relevant for the academic self-concept, because here, construct- rather than subject-specific variance components seem to be relatively low compared to measures of interest and anxiety (Gogol et al., 2017). It should be noted, however, that on the subject-specific level, expectancy and value beliefs seem so closely related (e.g., Gogol et al., 2017; Trautwein et al., 2012) that the two constructs may be difficult to disentangle, which may explain why others found no motivation profiles where expectancy and value “behaved” differently (Gaspard et al., 2019; Lazarides et al., 2021),

although there is indication for such multiplicative processes in variable-oriented research (e.g., Guo et al., 2015; Meyer et al., 2019). Nevertheless, it is promising that compensatory effects of conscientiousness have been reported for subject-specific value and expectancy components as well (Song et al., 2020; Trautwein et al., 2015). In terms of the breadth of motivational beliefs, we note that future research should entail a more differentiated perspective especially on value beliefs, because very different aspects of schooling can be valued or devalued (e.g., Eccles & Wigfield, 1995; Fong et al., 2021; Grund, 2013; Lee, Freer, et al., 2022; Vansteenkiste et al., 2009).

When looking at potentially outcomes of motivation, we stress that profile effects generally were rather uniform across the different subject domains, which is also reflected in the respective mean scores for test performance and grades. Taking into account again symmetry considerations, these mean composite scores may be most suitable for interpretation when it comes to the relation between motivation and academic achievement. Some caution in the interpretation of our results is also in order because of low internal consistencies for certain indicators of academic adjustment (i.e., school satisfaction) and because sample sizes sometimes differed considerably for each indicator, potentially being related to systematic dropout. Particularly, in our cross-year prediction of grades in Sample 2, we had to exclude students from the lowest track. It is also possible that certain groups of students are more likely to repeat a class or even drop out, which may have biased our findings, and we cannot rule out that students at schools that do not offer German differ from those at other schools. However, in these regards, it gives us confidence that overall, that is, across samples, many different indicators of academic adjustment, and different types of analyses, the respective patterns complement and corroborate each other quite well.

In this vein, it is nevertheless important to note that simply relating motivation profiles to indicators of academic adjustment precludes any causal inferences in the present study. We do not know whether motivation actually brings out competencies, school anxiety, and school satisfaction. It should also be considered that conceptualizing, for example, school anxiety as a criterion, reflecting a specific aspect of academic adjustment, and school interest as a predictor, contributing to the composition of a specific motivation profile, is to some degree arbitrary, as interest is also considered an outcome of schooling (e.g., Denissen et al., 2007). Similarly, anxiety could be conceptualized not only as an outcome of motivation, but also as a direct concomitant of a certain type of defensive motivation (Elliot & Thrash, 2002; Heckhausen, 1975), or it may even represent a cost component itself (cf., Eccles & Wigfield, 2002). In so far, the primary strength of the present study should not be seen in demonstrating that motivation determines academic adjustment to a certain degree, but rather as serving as a starting point for thinking about the manifold ways in which such an explanatory process may unfold. The inclusion of grades in Sample 2 may alleviate this concern to some degree, because grades in class 9 followed the assessment of motivation indicators, and motivation effects remained stable (and large) while controlling for prior grades as well as for gender and school track as relevant background variables for academic achievement.

Finally, we so far concentrated on the phenomenological diversity of academic motivation and its potential differential consequences. Hence, a next logical step would be to think about how a certain motivation profile is developed. Our findings related to students' gender may serve

as a first hint in this regard, as role stereotypes seem to affect expectancy and values beliefs rather early on in life (Eccles et al., 1993). In addition, in line with the intervention perspectives highlighted above, contextual features such as different teaching styles could be related to students' changes in academic motivation (Reeve et al., 2004), with a particular focus on students at risk (Hadjjar et al., 2021).

## 7. Conclusion

Understanding academic motivation is a complex endeavor that deserves a differentiated view. In an attempt to integrate different concepts via a typological approach, we could identify and replicate synergistic, compensatory, and interference processes among students' academic self-concept, interest, and conscientiousness, that may further our understanding on how motivation unfolds in schools, thereby eventually also providing specific ideas on how motivation and academic adjustment can be supported in students that struggle. Notably, while expectancy and value beliefs seem to co-occur often together, and therefore, may bring out motivation in a synergistic way, we found also some evidence for interference processes related to low expectancy beliefs as well as for compensating processes of high expectancy beliefs and conscientiousness. However, with regard to the latter, future research and practice should also attend to the potential downsides of such a "controlled" form of motivation. In addition, while our focus was on the complex ways in how motivation is expressed and may work in schools, we should not forget that motivation itself is also shaped by complex interactions between personal and contextual features.

## Compliance with ethical standards & data availability statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with animals performed by any of the authors.

Materials and analysis code for this study are available by emailing the corresponding author.

## CRediT authorship contribution statement

**Axel Grund:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Ineke M. Pit-ten Cate:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Antoine Fischbach:** Resources, Investigation, Writing – review & editing, Project administration.

## Conflict of interest

The authors declare that they have no conflict of interest.

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## Appendix A. Profile Constitution per Gender and School Track

Motivation profile	Gender				School Track					
	Male		Female		Highest track		Middle track		Lowest track	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
Highly motivated	49.0	48.0	51.0	52.0	35.0	35.2	55.5	54.5	9.5	10.2
Conscientiously motivated	48.8	49.6	51.2	50.4	29.2	28.0	62.4	62.7	8.3	9.3
Unconfident	45.8	46.4	54.2	53.6	20.1	20.1	66.9	67.7	13.0	12.2
Self-confident	69.8	69.5	30.2	30.5	32.1	31.4	58.4	57.5	9.5	11.0
Lowly motivated	64.5	62.1	35.5	37.9	24.2	24.8	62.7	62.1	12.9	13.1
Amotivated	61.8	57.5	38.2	42.5	15.2	15.8	60.0	70.8	24.8	13.3
Overall percentage	51.7	51.8	48.3	48.2	28.4	27.7	61.7	61.9	9.9	10.4

Note. Profile assignment is based on the highest classification likelihood per individual.

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