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# Clusters of test anxiety in lower secondary students: a cross-cultural comparison between France and Switzerland

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**Introduction:** This study investigates test anxiety among French and Swiss students. By combining variable-centered and person-centered approaches, it examines cross-cultural and gender differences to identify student profiles and guide tailored educational strategies.

**Methods:** A sample of 538 students (269 girls;  $M_{age} = 13.43$  years old) completed the French Revised Test Anxiety + Regulatory scale. Multi-group confirmatory factor analyses were used to establish measurement invariance. Variable-centered analyses ( $t$ -tests, ANOVAs) and person-centered cluster analyses were conducted to assess differences by country and gender.

**Results:** Measurement invariance across countries was confirmed. French and Swiss students showed similar overall anxiety levels, but Swiss students reported higher bodily symptoms. Gender differences were pronounced, with girls reporting higher levels of worry, tension, and bodily symptoms, and boys scoring higher in perceived control. Cluster analysis identified four profiles: *Tense*, *Low-test-anxious*, *Mind-wandering*, and *High-test-anxious* students. French students were more likely to fall into the "Tense" group, while Swiss students were overrepresented in the "High-test-anxious" cluster. Gender significantly influenced cluster membership, with girls more likely to be high in anxiety and low in control.

**Discussion:** Educational context might influence the experience of test anxiety beyond cultural similarity. Early academic selection in Switzerland may increase stress responses. Integrating perceived control into the model of test anxiety enhances understanding of student profiles and supports the development of targeted educational interventions to improve emotional regulation and academic success.

## KEYWORDS

test anxiety, cluster analysis, perceived control, emotion, cross-cultural comparison, lower secondary education

## 1 Introduction

While cross-cultural differences in anxiety are frequently discussed in the literature (e.g., Peleg and Messerschmidt-Grandi, 2019; Spielberger et al., 1990), test anxiety has also been the focus of comparative studies across geographic regions with highly contrasting educational and social contexts, such as North America, Europe, Asia, and South Africa (e.g., Lowe, 2019a; Lowe and Ang, 2012; Ringeisen et al., 2010). Some studies conducted in culturally similar countries, such as the United States and Canada,

have revealed converging trends – particularly higher levels of anxiety among female students – while also highlighting contextual specificities such as more pronounced physical symptoms among Canadian students (Lowe, 2019b). In contrast, within-Europe comparative studies remain relatively rare, and are often limited to measurement validation without directly examining cross-national differences in test anxiety levels (e.g., Chiesi et al., 2011). In this context, a comparative study between France and Switzerland – two countries that are geographically and culturally close but structurally distinct in terms of their educational systems – provides a valuable opportunity to explore differences in students' experience of test anxiety from a cultural and gendered dual perspective. This approach considers both structural (i.e., school system organization and tracking), subjective (i.e., students' experiences of test situations), and psychological (i.e., multidimensionality of test anxiety) levels. The principal objective of the present study is therefore to examine, in two educational contexts that are geographically close yet contrasting in their approach to academic selection, the dimensions of test anxiety that may affect students and to identify profiles based on their experiences and regulatory resources.

The theoretical framework adopted in this study conceptualizes test anxiety as a multidimensional construct comprising four negative dimensions – two cognitive (worry and test-irrelevant thinking) and two affective-physiological (bodily symptoms and tension) – as well as a positive regulatory dimension reflecting perceived control (Mascret et al., 2021). Initially considered as an antecedent of test anxiety or a moderator of exam performance (Martin and Marsh, 2008; Putwain and Aveyard, 2018), perceived control (i.e., the degree of certainty regarding the avoidance of poor performance and the achievement of good grades; Martin, 2007) is now recognized as a core component of anxiety, highlighting its regulatory dimension alongside the more traditional cognitive and affective-physiological components (Cheng et al., 2009). This perspective suggests that anxiety can inherently serve an adaptive function, helping individuals mobilize resources to cope with challenges (Nieuwenhuys and Oudejans, 2012). Initially validated in the context of sports anxiety (Cheng et al., 2009), perceived control was later confirmed in the more specific domain of test anxiety (Mascret et al., 2021; Valls, 2023). Perceived control allows students to activate cognitive and physiological resources to manage perceived threats during exams, thus shaping their response to test anxiety in real-time.

A cross-cultural comparative study requires that data be comparable not only in terms of measurement (i.e., use of a single, reliable, and robust measure), but also in terms of contextual factors (i.e., each country's educational system). In France, the centralized system is characterized by late tracking: students follow a common curriculum until the end of lower secondary education (collège), and are then oriented toward a general (academic or technological) or vocational training upon entering upper secondary education (Murdoch et al., 2014; Olympio and Di Paola, 2018). Lower secondary education lasts 4 years (ages 11 to 15) and ends with the *Diplôme National du Brevet* (DNB) obtained by a majority of students (e.g., 89% in 2023; N'guia, 2024). Although the DNB is not required for admission to upper secondary education, approximately two-thirds of students continue their education in

the general track (Iasoni and Schneider, 2023). In Switzerland, the education system is decentralized, with significant differences across cantons. In the canton of Vaud, academic tracking begins upon entry into lower secondary education (around age 12), with students placed in either a pre-gymnasial (academically oriented) or general (vocationally oriented) track, while allowing for annual reorientation based on academic performance (Murdoch et al., 2014; Olympio and Di Paola, 2018). Lower secondary education lasts 3 years (ages 12 to 15) and concludes with a certificate marking the end of compulsory schooling. While vocational training is more highly valued in Switzerland, the proportion of students in general education has been steadily increasing. In sum, although both systems emphasize academic achievement, they structure educational trajectories differently: early selection in Switzerland determines access to upper secondary education, whereas in France, later tracking and a more pronounced hierarchy between pathways influence educational trajectories (Olympio and Di Paola, 2018).

These structural differences between the French and Swiss education systems are mirrored in the trends observed in school-related stress and anxiety. In Switzerland, national surveys have shown that more than one-third of adolescents reported experiencing high levels of stress related to schoolwork (Delgrande Jordan et al., 2023; Albrecht et al., 2021). Students experiencing high stress levels also reported higher anxiety, lower subjective wellbeing, and reduced self-efficacy. In France, the proportions are similar, with a majority of students reporting moderate to high levels of school stress (Simoës-Perlant et al., 2023; Vansoeterstede et al., 2024). School-related anxiety can also be subject-specific. Data from the PISA 2022 results indicate, for example, that French students experience more anxiety in mathematics than Swiss students (Organisation for Economic Co-operation Development [OECD], 2023, 2024). This trend is commonly observed in countries whose average mathematics scores are above the OECD average, as is the case in Switzerland. Interestingly, this does not translate into a lack of self-confidence: French students rank among the best internationally in their ability to interpret graphical data and apply mathematics to real-world contexts, placing them at the top of the OECD in both categories. Finally, test anxiety is also more pronounced in France than in Switzerland: according to the PISA 2015 results (Organisation for Economic Co-operation Development [OECD], 2017), a majority of French students reported being afraid of failing an exam or getting poor grades (62% and 65%), compared with about half of Swiss students (48% and 56%). Focusing on specific data from this study (Table 1), we can note that each difference in proportions is statistically significant. Nevertheless, the magnitude of the effects remains small, even when comparing genders.

While previous studies have shown that the intensity and manifestations of test anxiety can vary between geographically close countries (e.g., Lowe, 2019b), comparisons between France and Switzerland are mainly based on broad indicators (e.g., PISA, HBSC) that reflect general trends but fail to capture the multidimensional complexity of test anxiety. This limitation is particularly relevant given that the French and Swiss education systems differ structurally in the emphasis they place on selection and academic tracking, which may influence how students perceive

**TABLE 1** Comparison between proportions of French and Swiss students who agreed/strongly agreed with statements about schoolwork anxiety in the PISA 2015 study.

Statements and comparison (proportion)	Difference in proportions	z	Effect size
<b>1. I often worry that it will be difficult for me taking a test</b>			
FR (0.62) vs. CH (0.48)	0.14	15.39	0.28
Girls: FR (0.73) vs. CH (0.57)	0.16	12.92	0.34
Boys: FR (0.51) vs. CH (0.39)	0.12	9.38	0.24
FR: Girls (0.73) vs. Boys (0.51)	0.22	17.73	0.46
CH: Girls (0.57) vs. Boys (0.39)	0.18	13.78	0.36
<b>2. I worry that I will get poor at school</b>			
FR (0.65) vs. CH (0.56)	0.09	10.07	0.18
Girls: FR (0.74) vs. CH (0.63)	0.11	9.12	0.24
Boys: FR (0.57) vs. CH (0.49)	0.08	6.23	0.16
FR: Girls (0.74) vs. Boys (0.57)	0.17	13.99	0.36
CH: Girls (0.63) vs. Boys (0.49)	0.14	10.78	0.28
<b>3. Even if I am well prepared for a test I feel very anxious</b>			
FR (0.47) vs. CH (0.34)	0.13	14.48	0.27
Girls: FR (0.55) vs. CH (0.41)	0.14	10.76	0.28
Boys: FR (0.39) vs. CH (0.26)	0.13	10.80	0.28
FR: Girls (0.55) vs. Boys (0.39)	0.16	12.52	0.32
CH: Girls (0.41) vs. Boys (0.26)	0.15	12.18	0.32
<b>4. I get very tense when I study</b>			
FR (0.29) vs. CH (0.21)	0.08	10.09	0.19
Girls: FR (0.33) vs. CH (0.23)	0.10	8.53	0.22
Boys: FR (0.25) vs. CH (0.19)	0.06	5.64	0.15
FR: Girls (0.33) vs. Boys (0.25)	0.08	6.88	0.18
CH: Girls (0.23) vs. Boys (0.19)	0.04	3.76	0.10
<b>5. I get nervous when I don't know how to solve a task at school</b>			
FR (0.55) vs. CH (0.35)	0.20	21.98	0.40
Girls: FR (0.61) vs. CH (0.40)	0.21	16.14	0.42
Boys: FR (0.48) vs. CH (0.29)	0.19	15.19	0.39
FR: Girls (0.61) vs. Boys (0.48)	0.13	10.20	0.26
CH: Girls (0.40) vs. Boys (0.29)	0.11	8.86	0.23

FR = French student data (N = 6108; 3111 girls and 2997 boys); CH = Swiss student data (N = 5860; 2807 girls and 3053 boys); all the differences are significant at  $p < 0.001$ . Data were extracted from the OECD report (Organisation for Economic Co-operation Development [OECD], 2017). Z-tests were performed on <https://www.socscistatistics.com/tests/ztest/default2.aspx> and verified on Excel?. The effect sizes reported correspond to Cohen's  $h$  with the following rules of thumb: 0.20 = small effect, 0.50 = medium effect, 0.80 = large effect (Cohen, 1988). OECD, PISA 2015 Database, Tables III.4.1 (doi: 10.1787/888933470845) and Table III.4.2 (doi: 10.1787/888933470677).

and experience evaluative situations. To understand how this anxiety manifests differently across students, it is necessary to move beyond these global comparisons and use instruments and methods capable of capturing the diversity of individual profiles. Our study therefore mobilizes a validated measure—the French Revised Test Anxiety + Regulatory scale (FRTA+R; Mascret et al., 2021; Valls, 2023)—which distinguishes cognitive, physiological, and regulatory components of test anxiety. The theoretical framework thus adopts a perspective that conceptualizes anxiety not only as a vulnerability factor but also as a potentially adaptive process,

while taking into account the context of educational systems. Moreover, although many studies on test anxiety have adopted a variable-centered approach, others have used a person-centered approach (e.g., Flanagan et al., 2015; Liu et al., 2022; Putwain and Daly, 2013; Stenlund et al., 2018; Thomas et al., 2018), offering a complementary framework to better understand the heterogeneity and complexity of individual profiles and reduce the inconsistencies observed in some findings. Consequently, our study proposes to combine a variable-centered approach aimed at identifying specific dimensions of test anxiety with

a person-centered approach designed to highlight differentiated student profiles based on their subjective experiences and regulatory resources. By identifying these profiles, the study goes beyond simple mean-level comparisons between countries to shed light on intra-cultural and inter-individual diversity. This more nuanced understanding can help inform targeted educational interventions tailored to the specific needs of each profile and the reality of educational contexts (Thomas and Ozer, 2024), particularly by strengthening perceived control which remains largely overlooked in most existing studies.

## 2 Materials and methods

### 2.1 Participants and study procedure

A total of 538 French and Swiss students (269 girls, 269 boys,  $M_{age} = 13.43$  years,  $SD = 1.00$ ) voluntarily participated in the present study. The French sample was composed of 280 collège students (136 girls, 144 boys,  $M_{age} = 13.36$  years,  $SD = 0.95$ ) from fifth to third grade classes, and the Swiss sample was composed of 258 students (133 girls, 125 boys,  $M_{age} = 13.50$  years,  $SD = 1.05$ ) from ninth to eleventh grade classes in the pre-gymnasial track (general academic training). In the Swiss education system, grades ninth, tenth, and eleventh correspond to the French fifth, fourth, and third grades, respectively, representing students aged between 12 and 15 years.

The data were gathered in a manner that ensured participants' anonymity. Each student's parents received an information letter detailing the global study's purpose (i.e., examining students' emotions during test situations) along with the supervisor's identity, the affiliated institution, and a contact address to uphold the duty of information. Participation was entirely voluntary, allowing both parents to opt their child out and students to decline involvement.

The students completed the questionnaire anonymously, which included the five subscales of test anxiety along with demographic details (gender, age, grade level). They had the option to discontinue the questionnaire at any time. The questionnaires were administered in paper format directly in the classroom by Master's students in Arts/Science who had received specific training for this purpose. Completion time ranged between 10 and 20 mins. The classroom teachers were not involved in supervising the completion process to minimize potential social desirability bias. The study was also approved by the Chief Education Officer and was conducted in accordance with the Code of Research Ethics for Universities of Teacher Education (Conférence des directeurs des Hautes Ecoles pédagogiques [CDHEP], 2002) and the International Ethical Guidelines for Health Research Involving Humans (Council for international organization of medical science [CIOMS], 2016).

### 2.2 Measure

The FRTA+R scale (Mascret et al., 2021) was used to assess test anxiety with five subscales: worry (e.g., "During tests I find myself thinking about the consequences of failing"), test-irrelevant thinking (e.g., "During tests I find I am distracted

by thoughts of upcoming events"), bodily symptoms (e.g., "I sometimes find myself trembling before or during tests"), tension (e.g., "During tests I feel very tense"), and perceived control (e.g., "During tests I believe that I have the resources to receive a good grade"). Students respond to each of the 18 items on a 4-point scale from almost never (1) to almost always (4).

The factorial invariance of the FRTA+R scale across gender and grade levels has already been shown (Mascret et al., 2021; Valls, 2023), and both studies reported good psychometric properties and an identical factorial structure, indicating that no cultural or linguistic adaptation was necessary. For the whole sample, internal consistency was considered satisfactory for worry ( $\alpha = 0.74$ ), test-irrelevant thinking ( $\alpha = 0.86$ ), bodily symptoms ( $\alpha = 0.77$ ), tension ( $\alpha = 0.84$ ), and perceived control ( $\alpha = 0.88$ ) subscales. The tendency was similar for both French and Swiss samples (respectively, worry  $\alpha = 0.69$  vs. 0.79; test-irrelevant thinking  $\alpha = 0.86$ ; bodily symptoms  $\alpha = 0.76$  vs. 0.78; Tension  $\alpha = 0.82$  vs. 0.85; perceived control  $\alpha = 0.85$  vs. 0.91).

### 2.3 Statistical analysis

#### 2.3.1 Preliminary analyses

The JASP software (version 0.16.2) and the SPSS software (version 30.0) were used to conduct the data analyses, with a level of significance initially defined at  $p < 0.05$ . The Holm-Bonferroni correction was used to judge significance because five consecutive statistical tests were performed on the same data set (Gaetano, 2013). The significance threshold has therefore been raised from  $p < 0.05$  to  $p < 0.01$ .

The sample of Swiss students included missing values, which were analyzed using Little's Missing Completely at Random test (MCAR; Little, 1988). Although the non-significant result indicated that the data was MCAR ( $\chi^2(283) = 320.06$ ,  $p > 0.05$ ) with no differences between those with and without missing values, multiple imputation was performed on the FRTA+R items to avoid biased estimates (i.e., 0.56% of Swiss data). Variables non-normal in distribution were identified with values  $\geq |2|$  for skewness and  $\geq |7|$  for kurtosis (Curran et al., 1996). Data normality was validated in the present study for the whole sample (skewness<sub>max</sub> = 1.18; kurtosis<sub>max</sub> = -1.16), the French sample (skewness<sub>max</sub> = 1.45; kurtosis<sub>max</sub> = 1.34), and the Swiss sample (skewness<sub>max</sub> = 0.94; kurtosis<sub>max</sub> = -1.22).

Outliers were identified using the interquartile range (IQR) multiplier rule with a value of 2.20 (Hoaglin and Iglewicz, 1987). They occurred for a single item (i.e., item 17: "I have difficulty breathing while taking a test"), for which 82% of the sample answered "1 = almost never". After carefully verifying that these values were not due to data entry errors, they were retained because they represented only 1% of the data. Moreover, item 17 refers to a significant physiological manifestation whose relatively low prevalence may explain why it is less frequently reported by students. These values were therefore interpreted as genuine observations reflecting natural population variability, consistent across both the French and Swiss samples.

### 2.3.2 Main analyses

In summary, multi-group confirmatory factor analyses (CFAs) were conducted to test the configural, metric, and scalar invariance of the FRTA+R scale across countries (Switzerland vs. France) using  $\Delta$ CFI and  $\Delta$ RMSEA criteria. Independent- and one-sample *t*-tests, along with ANOVAs, were performed to examine mean differences across subscales by country and gender, with effect sizes reported as Cohen's *d* (Cohen, 1988) and partial  $\eta^2$ . A two-step cluster analysis (hierarchical and K-means) was used to identify test anxiety profiles, and the stability of the cluster solution was verified through multiple fit and classification indices. Finally, the influence of country, gender, and educational level on cluster membership was assessed using chi-square tests and multinomial logistic regression. All these statistical analyses are detailed below.

To ensure cross-cultural equivalence of the FRTA+R scale, multi-group CFAs tested successive levels of structural invariance. Configural invariance was assessed by estimating overall model fit between groups (Chen et al., 2019). Because the  $\Delta\chi^2$  test is sensitive to sample size, metric and scalar invariance were examined using  $\Delta$ CFI and  $\Delta$ RMSEA tests, with changes not exceeding the recommended thresholds of  $\Delta$ CFI  $\leq 0.010$   $\Delta$ RMSEA  $\leq 0.015$  (Chen, 2007; Chen et al., 2019; Tod et al., 2012). Establishing invariance allowed the use of independent-sample *t*-tests to compare the scores of the five test anxiety subscales (worry, test-irrelevant thinking, bodily symptoms, tension, and perceived control) between French and Swiss samples.

To explore potential mean differences in test anxiety, consecutive one-sample *t*-tests (one per variable) were conducted within each sample to compare the mean of the scale (i.e., 2.50) with each score of the five test anxiety subscales. Several ANOVAs were then performed to examine the main and interaction effects of country (France vs. Switzerland) and gender (girls vs. boys) on these subscales. Post-hoc differences were evaluated using Holm tests.

A person-centered approach was adopted to identify profiles based on the five dimensions of the FRTA+R scale. Although latent profile analysis (LPA) is increasingly used to identify distinct test anxiety profiles (e.g., Broks et al., 2024; Journault et al., 2022; Thomas and Ozer, 2024), this method requires large samples, with simulation studies recommending at least 300 cases for most fit indices to perform adequately (Nylund-Gibson and Choi, 2018). Since the cross-cultural design of this study would have required conducting separate LPAs for the French and Swiss samples, followed by a multi-group LPA (MLPA) to test invariance in structure, dispersion and distribution (Morin et al., 2016), the risk of obtaining unstable solutions due to limited sample size was considered (Nylund-Gibson and Choi, 2018). Therefore, and in line with approaches used in previous studies (Flanagan et al., 2015; Putwain and Daly, 2013; Stenlund et al., 2018), two-step cluster analyses were conducted, as this method is particularly suitable when measurement instruments do not have threshold scores for participant classification (Lohiya et al., 2021). In addition, previous studies combining cluster and latent profile analyses have reported comparable and consistent results (Liu et al., 2022; Thomas et al., 2018). The required sample size was verified following Dolnicar et al. (2014), suggesting  $N \geq 70d$  (where *d* represents the number of indicators). With 538 students and five indicators, our sample largely met this criterion ( $N > 100d$ ).

As this study was exploratory, with no a priori assumptions regarding the number of underlying clusters, both hierarchical (Ward's method with squared Euclidean distance) and non-hierarchical (K-means) analyses were performed on standardized scores. Several criteria guided the choice of the final cluster solution: (1) visual inspection of the dendrogram; (2) examination of the agglomeration schedule to identify sudden increases in dissimilarity indicative of well-separated clusters (Clatworthy et al., 2005); (3) the elbow method using the within-cluster sum of squares (WCSS); (4) the percentage of variance explained by each variable; (5) the Calinski-Harabasz index, with higher values indicating better-separated clusters; and (6) discriminant analyses using classificatory variables to predict cluster membership, with Wilks' Lambda ( $\lambda \leq 0.90$ ) and Kappa coefficients ( $\kappa \geq 0.80$ ; Landis and Koch, 1977) used to assess classification reliability. The combined examination of these indices determined the optimal cluster solution.

Finally, the potential influence of country (1 = France vs. 0 = Switzerland), gender (1 = boys vs. 0 = girls), and educational degree (1 = 3<sup>rd</sup>/11<sup>th</sup>; 2 = 4<sup>th</sup>/10<sup>th</sup>; 3 = 5<sup>th</sup>/9<sup>th</sup>) on cluster composition was tested using both unadjusted analyses (chi-square test, Cramer's V, and z-tests for independent proportions) and adjusted analyses (multinomial logistic regression) estimating odds ratios while controlling for all covariates.

## 3 Results

### 3.1 Preliminary results

Measurement invariance tests for FRTA+R across countries are summarized in Table 2. Despite higher CFI and lower RMSEA values for the Swiss sample, goodness-of-fit indices confirm configural, metric, and scalar invariance, with no significant change in CFI or RMSEA between models.

### 3.2 Main results: variable-centered analysis

Descriptive statistics are presented in Table 3. The results of the *t*-tests for independent samples (Figure 1) highlighted that no significant differences were found between the scores of French and Swiss students on worry ( $p = 0.201$ ), test-irrelevant thinking ( $p = 0.010$ ), tension ( $p = 0.230$ ), and perceived control ( $p = 0.732$ ). However, the scores of bodily symptoms were significantly higher for Swiss students than for French students ( $t(536) = -3.39$ ,  $p < 0.001$ ,  $d = 0.09$ ). While these initial results provide interesting information on the comparison of scores between French and Swiss students, they do not give any indication of the students' levels of test anxiety.

This issue can be overcome using the results of the one-sample *t*-tests (Figure 1). French students' and Swiss students' scores of worry and bodily symptoms were significantly lower than the mean of the scale (all  $p < 0.001$ , with Cohen's *d* ranging between 0.06 and 0.09), indicating that these two subscales of test anxiety are rather under-represented among students in these two countries. As shown in Figure 1, French students' and Swiss students' scores of tension and perceived control were not significantly different

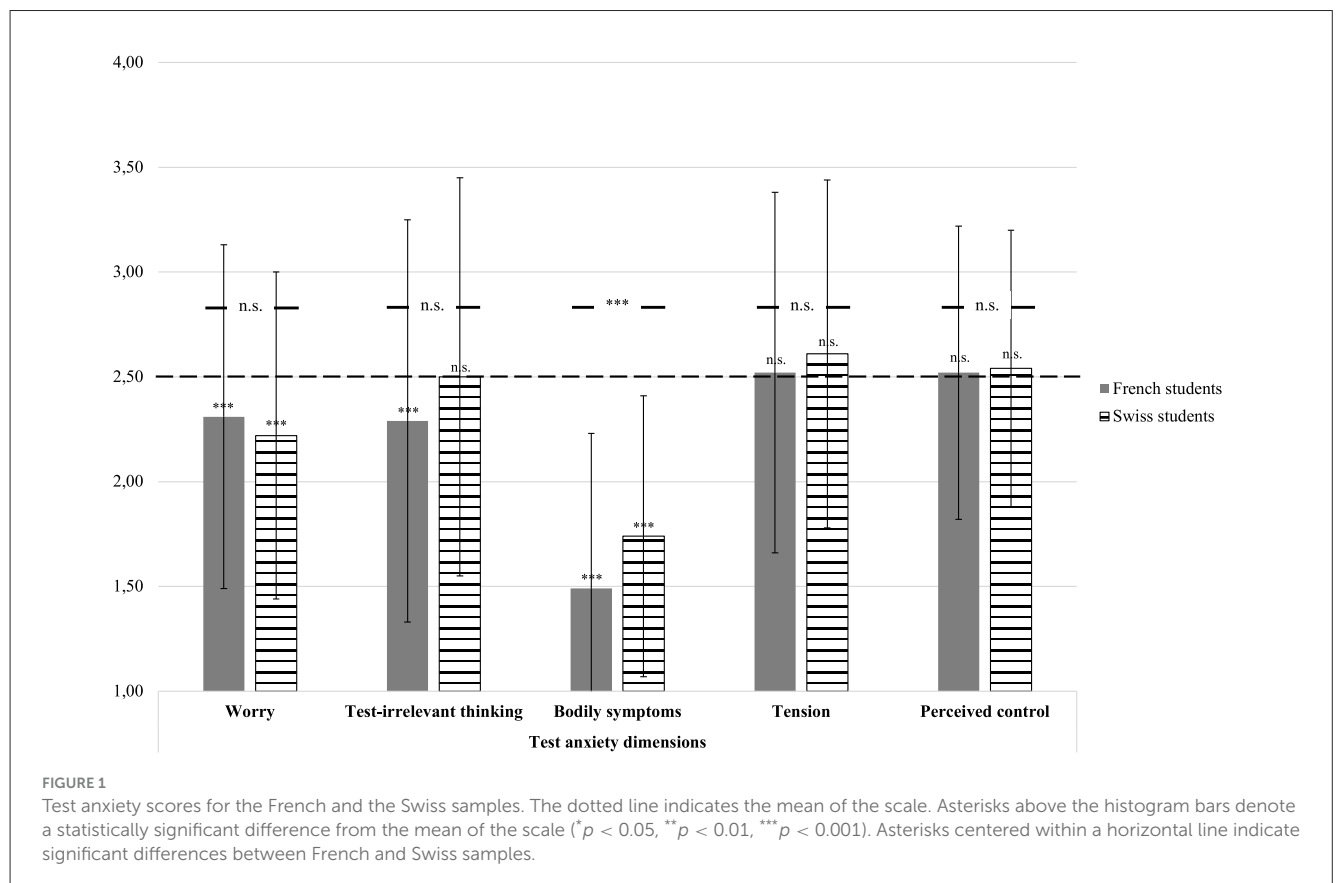
TABLE 2 Fit indices of multi-group analyses of invariance across countries.

Samples and measurement invariance steps	$\chi^2$ (df)	CFI	RMSEA (CI)	$\Delta\chi^2$ ( $\Delta df$ )	<i>p</i>	$\Delta$ CFI	$\Delta$ RMSEA
Total	276.89*** (125)	0.967	0.048 (0.040 - 0.055)				
France	243.89*** (125)	0.942	0.058 (0.047 - 0.069)				
Switzerland	194.04*** (125)	0.974	0.046 (0.033 - 0.059)				
Configural	437.93*** (250)	0.960	0.053 (0.045 - 0.061)				
Metric	451.31*** (263)	0.960	0.052 (0.043 - 0.060)	13.38 (13)	0.419	0.000	0.001
Scalar	487.12*** (276)	0.955	0.053 (0.045 - 0.061)	35.81 (13)	0.001	0.005	0.001

\*\*\**p* < 0.001.

TABLE 3 Descriptive statistics.

Test anxiety dimensions	Means and standard deviations	Full sample	French students	Swiss students
Worry	M	2.26	2.31	2.22
	SD	0.82	0.78	0.86
Test-irrelevant thinking	M	2.39	2.29	2.50
	SD	0.96	0.95	0.96
Bodily symptoms	M	1.61	1.49	1.74
	SD	0.74	0.67	0.79
Tension	M	2.56	2.52	2.61
	SD	0.86	0.83	0.90
Perceived control	M	2.53	2.52	2.54
	SD	0.70	0.66	0.74



from the mean of the scale (all  $p > 0.058$ ), indicating that these two subscales of test anxiety are neither rejected by students, nor highlighted as predominant. The only difference between the two countries concerns the test-irrelevant thinking subscale: while the test-irrelevant thinking score is significantly lower than the scale average for French students ( $p < 0.001$ ), it is not significantly different for Swiss students ( $p = 0.948$ ). This result tends to show that this subscale of test anxiety is dismissed by French students, unlike Swiss students, who neither dismiss it nor identify it as predominant.

Concerning the analysis of the effects on the test anxiety scores of gender, country, and their interaction, a significant effect of Gender was found on scores of worry, bodily symptoms, tension, and perceived control. No significant direct effect was found for test-irrelevant thinking. Girls' scores of worry, bodily symptoms, and tension were significantly higher than boys' scores, while boys' perceived control score was significantly higher than girls' score. A significant effect of Country was found on scores of bodily symptoms only, with higher scores for Swiss students than for French students, confirming the previous results of the  $t$ -tests for independent samples. No significant interaction effects gender X country have been found for any of the test anxiety subscales, except for perceived control. Holm post-hoc tests indicated on one hand that perceived control was significantly higher for Swiss boys compared to Swiss girls and on the other hand that it was higher for French boys compared to French girls. No other significant differences have been identified, especially between Swiss and French girls and between Swiss and French boys. Detailed results are presented in [Table 4](#).

### 3.3 Person-centered analyses

Analysis of the dendrogram and agglomeration schedule suggests several possible solutions ranging from two to four clusters. The greatest change in agglomeration coefficients occurred when one cluster was merged into two, although notable changes also appeared when moving from two to three and three to four clusters ([Table 5](#)). Euclidean distances showed a substantial increase when five clusters were merged into four (1326.27 to 1461.58), while WCSS values indicated no further significant reduction beyond four clusters ([Figure 2](#)). The two-cluster solution explained only 1.50% of the variance in test-irrelevant thinking and 22.72% in perceived control, whereas the five-cluster solution explained 72.48% and 23.64% respectively. The explained variance was more homogeneous in the three- and four-cluster solutions (respectively, worry = 52.52% vs. 53.91%; test-irrelevant thinking = 44.96% vs. 56.61%; bodily symptoms = 60.51% vs. 66.89%; tension = 57.82% vs. 60.73%; perceived control = 38.13% vs. 36.27%).

Although the Calinski-Harabasz index was higher for the three-cluster solution ([Table 5](#)), discriminant revealed clearer group separation for the four-cluster solution (Wilks'  $\lambda = 0.09$ ;  $F_{\text{Approx}(549008.21)} = 5.44$ ;  $p < 0.001$ ;  $\kappa = 0.96$ ) compared with the three-cluster solution (Wilks'  $\lambda = 0.14$ ;  $F_{\text{Approx}(30;633286)} = 6.23$ ;  $p < 0.001$ ;  $\kappa = 0.94$ ). The most discriminating variables in both solutions were bodily symptoms (Wilks'  $\lambda = 0.36$  vs. 0.40), tension (Wilks'  $\lambda = 0.40$  vs. 0.42) and worry (Wilks'  $\lambda = 0.47$  vs. 0.48).

Perceived control was less discriminating in the three-cluster than in the four-cluster solution (Wilks'  $\lambda = 0.71$  vs. 0.62), and test-irrelevant thinking was not discriminating at all in the three-cluster solution (Wilks'  $\lambda = 0.93$  vs. 0.55). At a qualitative level, the four-cluster solution provided more clinical information concerning the potential regulating effect of perceived control and the relationships between worry, bodily symptoms, and tension. The four-cluster solution was therefore chosen.

[Figure 3](#) shows the standardized mean levels of each cluster for each variable. Cluster 1 ( $n = 126$ ; 23.42% of total sample) is characterized by high tension (above the sample mean by  $>0.5$  SD), moderate worry and bodily symptoms (slightly above the sample means,  $<0.5$  SD), low test-irrelevant thinking (below the sample mean by  $>0.5$  SD), and moderate perceived control (slightly below the sample mean,  $<0.5$  SD). It was named "Tense students". Cluster 2 ( $n = 151$ ; 28.07% of the total sample) reported low worry, bodily symptoms, and tension (all below the sample means by  $>0.5$  SD), moderate test-irrelevant thinking (below the sample mean by 0.5 SD), and high perceived control (above the sample mean by  $>0.5$  SD). This cluster was called "Low-test-anxious students". Cluster 3 ( $n = 162$ ; 30.11% of the total sample) reported high test-irrelevant thinking (above the sample mean by  $>0.5$  SD) and moderate levels for the other four variables (all slightly below the sample means,  $<0.5$  SD). It has been named "Mind-wandering students". Finally, cluster 4 ( $n = 99$ ; 18.40% of the total sample) is characterized by high worry, body symptoms, and tension (above the sample means by  $>1$  SD), moderate test-irrelevant thinking (slightly above the sample mean,  $<0.5$  SD), low perceived control below the sample mean by  $>0.5$  SD). This last cluster was named "High-test-anxious students".

Results of unadjusted analyses showed that the distribution of student proportions in the clusters was dependent of country ( $\chi^2(3) = 10.60$ ,  $p < 0.05$ ; Cramer V = 0.14) and gender ( $\chi^2(3) = 29.88$ ,  $p < 0.001$ ; Cramer V = 0.24), but not of level of education ( $\chi^2(6) = 9.28$ ,  $p = 0.159$ ; Cramer V = 0.09). [Table 6](#) shows the proportions of students in each of the four clusters. French students are more likely to belong to profile 1 "Tense students" compared to Swiss students ( $z = -2.98$ ,  $p < 0.01$ ), while the opposite trend is found for profile 4 "High-test-anxious students" ( $z = 2.12$ ,  $p < 0.05$ ). Girls were more likely to belong to profile 4 "High-test-anxious students" ( $z = 3.72$ ,  $p < 0.001$ ) and boys to profile 2 "Low-test-anxious students" ( $z = -5.01$ ,  $p < 0.001$ ).

Results of the multinomial logistic regression analyses ([Table 7](#)) confirm that French students are more likely than Swiss students to belong to cluster 1, compared with the other three. The other three clusters cannot be differentiated by country. Also, boys are more likely to belong to cluster 2 compared to the other three clusters, and to cluster 3 "Mind-wandering students" compared to cluster 4. However, gender does not differentiate cluster 1 from clusters 3 and 4.

## 4 Discussion

This study aimed to investigate the manifestations of test anxiety among students by combining a cross-cultural perspective (France vs. Switzerland) with a gender-based approach. Using both a variable-centered and a person-centered approach, our objective

TABLE 4 Results of the ANOVAs.

Test anxiety dimensions	Variables	df	Residuals	F	p	$\eta^2p$
Worry	Gender	1	534	30.047	<0.001	0.053
	Country	1	534	2.193	0.139	0.004
	Gender x Country	1	534	2.201	0.139	0.004
Test-irrelevant thinking	Gender	1	534	0.290	0.590	$5.432 \times 10^{-4}$
	Country	1	534	6.578	0.011	0.012
	Gender x Country	1	534	0.830	0.363	0.002
Bodily symptoms	Gender	1	534	24.679	<0.001	0.044
	Country	1	534	14.329	<0.001	0.026
	Gender x Country	1	534	6.403	0.012	0.012
Tension	Gender	1	534	47.877	<0.001	0.082
	Country	1	534	1.096	0.296	0.002
	Gender x Country	1	534	4.725	0.030	0.009
Perceived control	Gender	1	534	55.544	<0.001	0.094
	Country	1	534	0.343	0.558	$6.426 \times 10^{-4}$
	Gender x Country	1	534	7.236	0.007	0.013

TABLE 5 Results and criteria of the hierarchical cluster analysis.

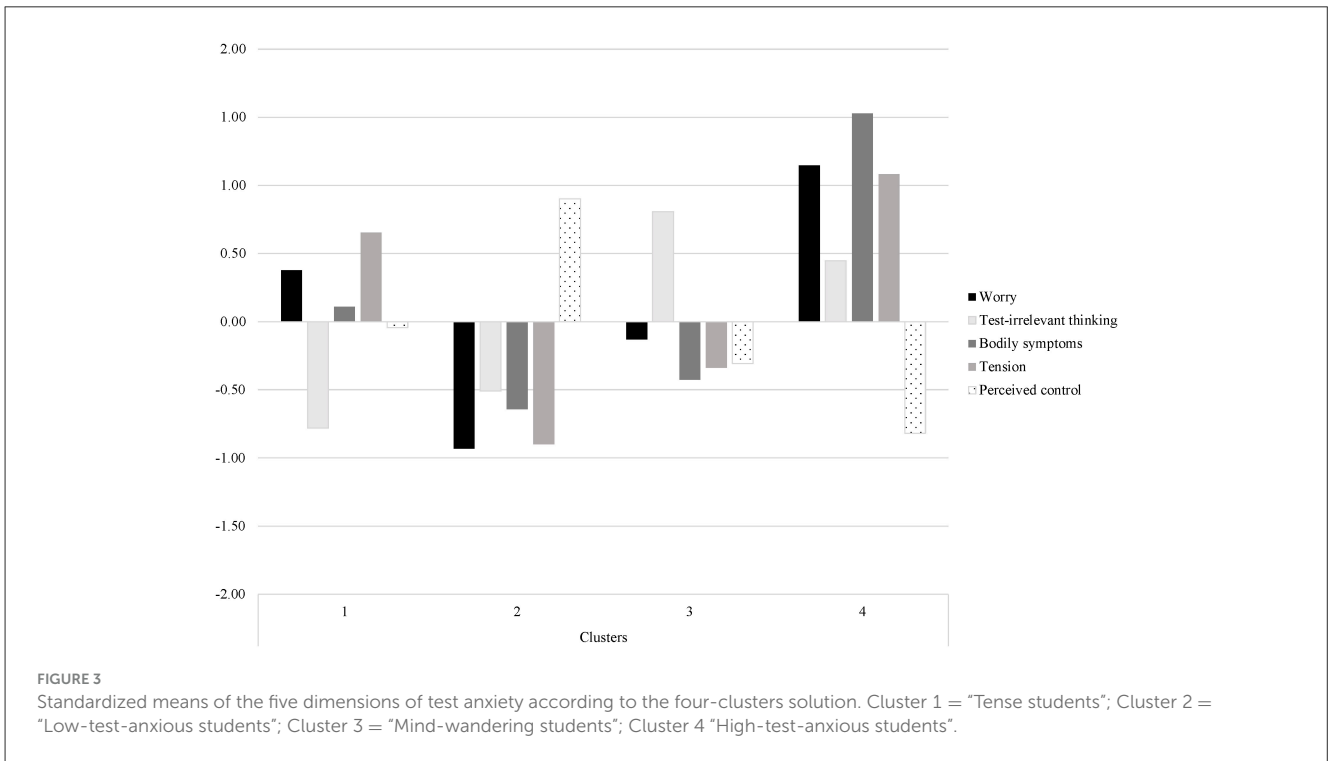
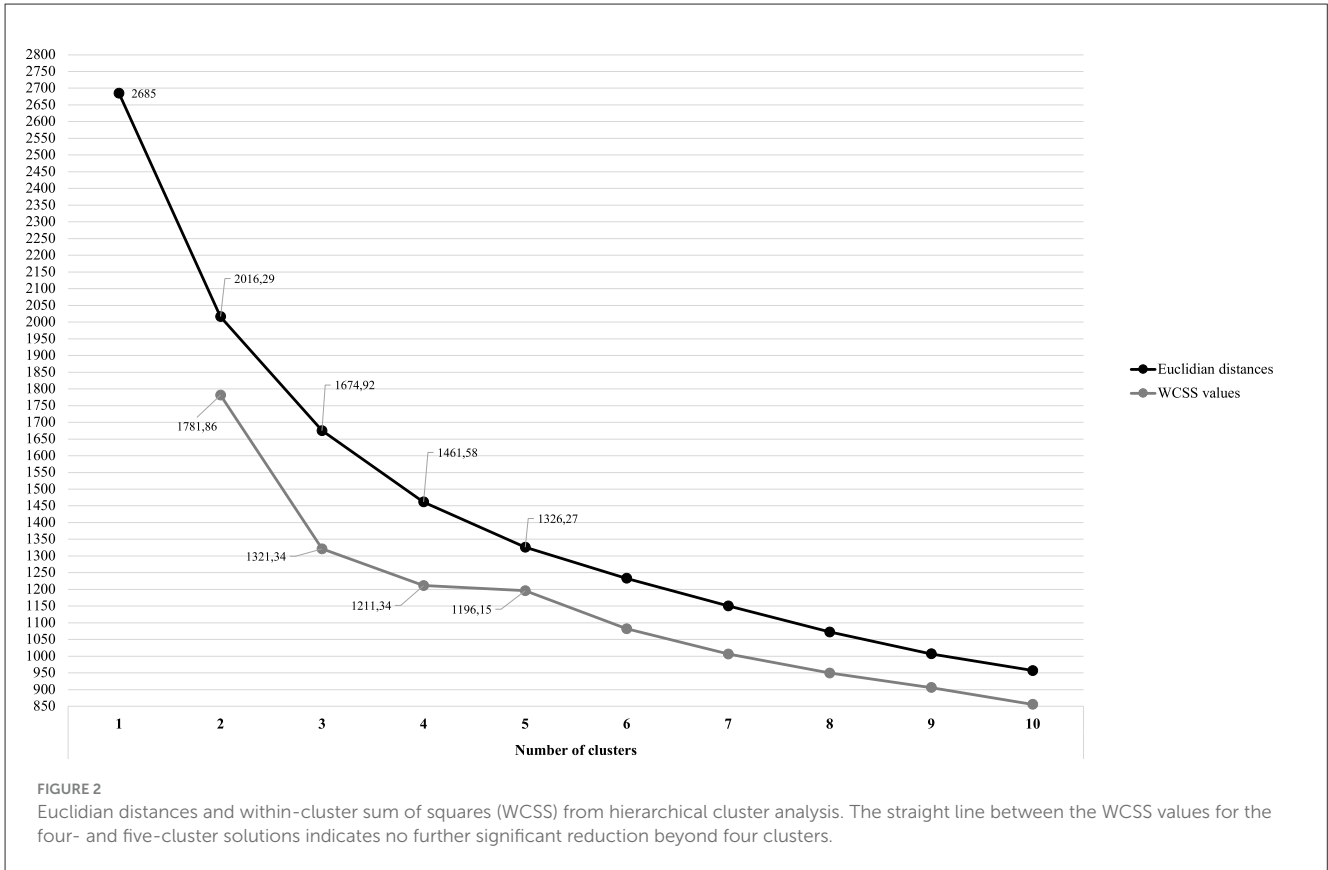
Number of clusters	Agglomeration coefficient	Change from next level (%)	Calinski-Harabasz index
10	957.24	4.95	125.39
9	1007.10	6.11	129.79
8	1072.64	6.76	138.35
7	1150.36	6.71	147.51
6	1233.16	7.02	157.61
5	1326.27	9.26	165.86
4	1461.58	12.74	216.55
3	1674.92	16.93	276.07
2	2016.29	24.91	271.67
1	2685.00	—	—

was to identify not only global differences in test anxiety levels, but also specific symptom configurations according to school context and students' subjective experiences. Particular attention was given to the role of perceived control, as a core regulatory dimension inherent to test anxiety. This dual approach made it possible to move beyond conventional comparisons and gain a more nuanced understanding of how test anxiety can manifest across educational contexts and individual characteristics.

Findings from the variable-centered approach showed few differences between the two countries, except for higher bodily symptoms among Swiss students. Although the dimensions of test anxiety appeared relatively stable across culture, this difference may reflect a more somatic expression of test anxiety within the Swiss educational context (canton of Vaud), where academic tracking occurs earlier and relies more on performance. However, this result was not confirmed by the person-centered analysis results, as no profile characterized by high bodily symptoms level was identified.

In contrast, gender effects were clearly observed: girls reported higher levels of test anxiety and lower levels of perceived control. These findings are consistent with previous studies (e.g., [Lowe, 2019b](#); [Mascret et al., 2021](#); [Valls, 2023](#)) as well as adjusted analyses showing that profile 4 (i.e., high symptom levels and low perceived control) was more frequent among girls whereas profile 2 (i.e., low symptoms levels and high perceived control) was predominantly male. These results reinforce the need for differentiated support measures to promote emotional regulation and the development of adaptive coping strategies among female students. Finally, comparison with PISA 2015 data ([Organisation for Economic Co-operation Development \[OECD\], 2017](#)) highlights the relevance of using a multidimensional measure of test anxiety.

The person-centered approach yielded four distinct student profiles, revealing the diversity of manifestations and intensity of test anxiety. The "Tense students" profile (i.e., cluster 1) is characterized by high tension and moderate perceived control,



and is more frequent among French students. These students appear anxious about tests yet academically engaged and able to mobilize their resources despite some tension and worry. This profile illustrates the potentially adaptive function of anxiety, in

which perceived control helps regulate its effects (Cheng et al., 2009; Mascret et al., 2021). The overrepresentation of French students in this profile can be interpreted in light of the country’s educational context, where assessments (such as the DNB) do not yet determine

TABLE 6 Proportion (n) of students in each cluster across countries and gender.

Students by country and gender		1. Tense students	2. Low-test-anxious students	3. Mind wandering students	4. High-test-anxious students
CH	Girls	24.10% (32)	18.00% (24)	28.60% (38)	29.30% (39)
	Boys	11.20% (14)	40.80% (51)	33.60% (42)	14.40% (18)
	Total	17.83% (46)	29.07% (75)	31.01% (80)	22.09% (57)
FR	Girls	27.90% (38)	19.10% (26)	33.10% (45)	19.90% (27)
	Boys	29.20% (42)	34.70% (50)	25.70% (37)	10.40% (15)
	Total	28.57% (80)	27.14% (76)	29.29% (82)	15.00% (42)
Country	CH	36.50% (46)	49.70% (75)	49.40% (80)	57.60% (57)
	FR	63.50% (80)	50.30% (76)	50.60% (82)	42.40% (42)
Gender	Girls	55.60% (70)	33.10% (50)	51.20% (83)	66.70% (66)
	Boys	44.40% (56)	66.90% (101)	48.80% (79)	33.30% (33)

CH = Swiss student data (N = 538; 133 girls and 125 boys); FR = French student data (N = 280; 136 girls and 144 boys).

TABLE 7 Odds ratio on predicted likelihood of belonging to identified clusters.

Reference vs. compared profiles	Variables	Odds ratio	(CI 95%)	p
Cluster 1 vs. 2	Country	0.57	(0.35–0.93)	0.023
	Gender	2.57	(1.57–4.19)	<0.001
Cluster 1 vs. 3	Country	0.59	(0.36–0.94)	0.028
	Gender	1.21	(0.76–1.93)	0.431
Cluster 1 vs. 4	Country	0.43	(0.25–0.74)	0.002
	Gender	0.64	(0.37–1.11)	0.113
Cluster 2 vs. 3	Country	1.03	(0.66–1.62)	0.887
	Gender	0.47	(0.30–0.74)	0.001
Cluster 2 vs. 4	Country	0.76	(0.45–1.28)	0.295
	Gender	0.25	(0.15–0.43)	<0.001
Cluster 3 vs. 4	Country	0.73	(0.44–1.22)	0.227
	Gender	0.53	(0.32–0.89)	0.017

Odds ratios are interpreted in terms of variation in chances: the likelihood of belonging to the compared cluster decreases for each unit increase in the variable when odds ratio <1.00, while it increases for each unit increase in the variable when odds ratio >1.00. Country: 0 = Switzerland vs. 1 = France; Gender: 0 = girls vs. 1 = boys; CI= confidence interval.

academic tracking, and test pressure may therefore be lower than in more selective systems.

Conversely, the “High-test-anxious students” profile (cluster 4), more common among Swiss students, reflects vulnerability with high levels in three negative dimensions (including Bodily Symptoms, which thus form part of a globally anxious profile) and low perceived control. Its overrepresentation among Swiss students may be explained by the context of the canton of Vaud, where early selection can expose students to strong performance pressure and the threat of reorientation toward vocational tracks, thereby contributing to test anxiety. Thus, general academic training would not necessarily protect students from anxiety when the threat of failure is present.

The two remaining profiles also provide additional insights. The “Low-test-anxious students” profile (cluster 2), predominantly male and consistent with previous studies (e.g., Lowe, 2019b; Mascret et al., 2021; Putwain and Daly, 2014; Valls, 2023), includes students who are little affected by testing and display high perceived

control. This profile may reflect good academic adjustment, a positive perception of competence (whether realistic or not) and a perception of tests as less threatening to the self. The “Mind-wandering students” profile (cluster 3) is characterized by few symptoms except a high level of test-irrelevant thinking. Mind-wandering, defined as a state of distraction involving a shift of attention toward thoughts unrelated to the current task (Ziane et al., in press), may reflect partial cognitive disengagement. Although it can sometimes be associated with both cognitive and behavioral benefits, it has also been linked to anxiety symptoms in adolescents (Figueiredo et al., 2020). This profile may represent students less academically engaged or who adopt disengagement strategies to cope with perceived threats.

Overall, these profiles highlights the importance of perceived control as a key component of test anxiety. Similar levels of tension may reflect very different experiences depending on students’ ability to activate their regulatory resources. These findings support a multidimensional conceptualization, in which perceived control

is not merely an external factor but a constitutive component of test anxiety experience (Mascret et al., 2021). They also emphasize the importance of tailoring educational responses to students' emotional and cognitive needs.

The “Tense students” and “High test-anxious students” profiles, characterized by anxiety before tests, could benefit from interventions such as expressive writing exercises prior to examinations (Ramirez and Beilock, 2011) or programs focused on improving perceived control. Interventions more focused on attentional aspects (particularly sustained attention) could also help students displaying the “Mind-wandering” profile (e.g., Mrazek et al., 2022; Price et al., 2023). Finally, interventions centered on relaxation and breathing techniques appear effective for reducing test anxiety in general (e.g. Cho et al., 2016).

Given that teachers play a central role in regulating test anxiety, it seems crucial to support them in implementing explicit and constructive feedback practices. Clear, explicit and task-oriented feedback (i.e., action-oriented rather than person-oriented) helps create a secure learning environment that fosters perceived control by strengthening students' sense of controllable competence (Hattie and Timperley, 2007; Margolis and McCabe, 2006). As Hattie and Timperley (2007) point out, effective feedback must answer three key questions: Where am I going? How am I going? Where to next? (p. 86). Margolis and McCabe (2006) describe this type of feedback as a true “map for success”, stimulating engagement and motivation. By providing clear reference points, such feedback reduces ambiguity and refocuses students' attention on the actions they can take to progress.

It is also essential to consider the causal attributions conveyed through some feedback. When feedback focuses on controllable and modifiable factors (e.g., effort or strategies used), it increases student engagement and encourages the adoption of functional attributions by helping interpret their successes or failures as the result of their own actions (Margolis and McCabe, 2006; Stewart et al., 2011). Finally, acknowledging recent progress strengthens students' confidence in their abilities (Margolis and McCabe, 2006) and provides guidance to help them develop effective learning strategies.

## 4.1 Limitations of the study

Findings from the present study should be interpreted with caution due to several limitations related to sample characteristics, research design, and uncontrolled variables. First, participants were recruited using a convenience sampling method based on their accessibility and availability. This method may have introduced selection bias, limiting the representativeness of the students and the generalizability of the findings. Nevertheless, the study provides a meaningful overview of trends observed in two comparable educational contexts, which can serve as a basis for future research conducted on larger, randomly selected samples. Moreover, although the overall sample size was adequate for an exploratory approach, it remained restricted for person-centered analyses. This constraint led to favor cluster analysis rather than a more robust LPA. It also limited the exploration of complex interaction between gender and school context in the multinomial regression analyses. The identified profiles should

therefore be considered specific to our sample, and their stability should be examined in future studies conducted in other cultural and educational contexts.

The cross-sectional design of this study represents another limitation, as it does not allow for the assessment of change in test anxiety profiles over time or for evaluating how perceived control might evolve along different educational trajectories. In addition, the Swiss sample included exclusively students enrolled in the pre-gymnasial (general academic) track from a single canton. This track, generally perceived as more academically demanding, may expose students to greater academic pressure than the vocational track, potentially leading to an overestimation of test anxiety in this context. As school orientation occurs later in France than in Switzerland, it would be valuable to replicate this study with a sample of upper secondary students (aged 15 and over) to explore the role of educational track in the experience of test anxiety. In addition, inter-cantonal comparative studies in Switzerland would help to examine more precisely the impact of early academic orientation. Finally, the lack of data on students' academic performance limits the possibility of examining direct links between test anxiety profiles and academic achievement. Such analyses would be essential to better understand the regulatory function of perceived control in the relationship between test anxiety and performance.

## 5 Conclusion

Although the scope of the findings should be interpreted with caution given the cultural similarities between France and Switzerland, this study confirms the relevance of a multidimensional approach to test anxiety that integrates the regulatory component of perceived control. The complementary of variable- and person-centered approaches helps overcome some of the limitations of conventional analyses by revealing nuanced and complex individual profiles. Comparative studies conducted in more contrasting or geographically distant education systems would further enrich these findings and refine our understanding of the contextual factors associated with test anxiety. The conclusions of this study also have practical implications for the field of educational: they underline the need for targeted and differentiated interventions, as well as training for teachers aimed at detecting manifestations of test anxiety. Such actions indispensable for adapting pedagogical practices, particularly in high-selective educational contexts, where even the highest-performing students may develop forms of test anxiety that are often underestimated.

## Data availability statement

The data analyzed in this study is available on request. Requests to access these datasets should be directed to Marjorie Valls, [marjorie.valls@hepl.ch](mailto:marjorie.valls@hepl.ch).

## Ethics statement

The study was approved by the Chief Education Officer and was conducted in accordance with the Code of Research Ethics for

Universities of Teacher Education ([Conférence des directeurs des Hautes Ecoles pédagogiques \[CDHEP\], 2002](#)) and the International Ethical Guidelines for Health Research Involving Humans ([Council for international organization of medical science \[CIOMS\], 2016](#)). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements because in order to respect the duty to inform, each parent was informed by letter of the general objectives of the study, the identity of the supervisors (with a contact address) and the names of the institutions involved, and could decline their child's participation in the data collection. Under this condition, no refusals were recorded and the anonymity of the participants was preserved.

## Author contributions

MV: Project administration, Formal analysis, Methodology, Conceptualization, Writing – review & editing, Writing – original draft, Investigation. GS: Writing – review & editing, Writing – original draft, Formal analysis. ET: Writing – original draft. NM: Methodology, Formal analysis, Writing – review & editing, Conceptualization, Project administration, Writing – original draft, Investigation.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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