

## Psychometric properties of the Portuguese version of the Achievement Emotions Questionnaire for Elementary School

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The main purposes of the current research were to translate and adapt the Achievement Emotions Questionnaire – Elementary School (AEQ-ES) into Portuguese and to analyze its psychometric properties. A sample of 350 Portuguese third and fourth graders (aged 7 to 12 years) completed the Portuguese version of the AEQ-ES (AEQ-ES-P). As does the original version, the AEQ-ES-P measures students' enjoyment, boredom, and anxiety toward mathematics in three academic settings: attending class, doing homework, and taking tests. Confirmatory factor analysis corroborated the hierarchical structure of the AEQ-ES-P, which was also invariant across gender and grades. The instrument also showed good reliability and temporal stability. Significant correlations were found in the expected direction between enjoyment, anxiety, and boredom, as well as between these emotions, students' perceptions of competence, and intrinsic motivation toward mathematics, thus supporting the internal and external validity of the questionnaire. These results indicate that the AEQ-ES-P presents good psychometric properties and is suitable to measure the achievement emotions of Portuguese elementary-school children of the third and fourth grades in the domain of mathematics.

**Key words:** Achievement emotions, Anxiety, Boredom, Enjoyment, Elementary students.

Emotional experiences play a crucial role in peoples' lives, strongly influencing their behavior and well-being. The control-value theory of achievement emotions (CVT; Pekrun, 2006) explains the role of students' emotions in achievement settings, identifying the factors underlying different emotional experiences as well as their potential effects. Pekrun (2006) defines achievement emotions as prospective, concurrent, or retrospective affective reactions directly linked to achievement activities (such as attending classes, studying, or doing homework) or achievement outcomes (such as success or failure in tests, school performance, or grades). Achievement emotions can have a positive *vs.* negative valence (e.g., enjoyment or pride *vs.* anger or boredom), and they can also be classified as physiologically activating *vs.* deactivating (e.g., enjoyment, hope, or anxiety *vs.* relief, boredom, or hopelessness) (Pekrun, 2006; Pekrun & Perry, 2014). Another characteristic of achievement emotions is that they are domain- and context-specific (Pekrun, 2006). Students report differing emotional experiences (e.g., enjoyment, pride, boredom, anxiety, or anger) towards different academic domains (e.g., English language, mathematics, science), and when referring to different academic activities (e.g., attending classes, doing

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homework, taking tests) (e.g., Goetz, Nett, Martiny, Hall, & Pekrun, 2012; Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011; Raccanello, Brondino, Moè, Stupnisky, & Lichtenfeld, 2018).

### *The antecedents and consequences of achievement emotions*

According to CVT (Pekrun, 2006; Pekrun & Perry, 2014), achievement emotions are influenced by individual factors (e.g., personality) and by contextual factors (e.g., classroom environment, teacher support), which are posited to affect two critical and more proximal antecedents of the emotions experienced by students in academic settings: control appraisals (perceived competence, expectations, and attributions) and value appraisals (the perceived value of activities or outcomes). Different combinations of control and value appraisals will therefore trigger different achievement emotions (e.g., Putwain, Pekrun, et al., 2018). For example, research has shown that the perception of having high control in a highly valued school task elicits positive emotions such as enjoyment (e.g., Buff, 2014; Putwain, Pekrun, et al., 2018) or pride (e.g., Peixoto, Sanches, Mata, & Monteiro, 2017), while perceiving low control in an undervalued task is associated with hopelessness (e.g., Peixoto et al., 2017). Boredom can arise from perceptions of either high or low control in undervalued tasks (e.g., Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010; Pekrun, Hall, Goetz, & Perry, 2014; Putwain, Pekrun, et al., 2018), and anxiety can be elicited when students perceive low control in a highly valued task (e.g., Henschel & Roick, 2017; Lauermaun, Eccles, & Pekrun, 2017; Lohbeck, Nitkowski, & Petermann, 2016).

According to CVT (Pekrun, 2006) and extensive supporting evidence, these different emotional experiences will in turn have a strong impact on several achievement outcomes, such as students' cognitive resources, motivation to learn, persistence, learning strategies, self-regulation, achievement, and performance (e.g., Mouraditis & Michou, 2011; Obergriesser & Stoeger, 2016; Pekrun et al., 2010; Pekrun, Lichtenfeld, Marsh, Murayama, & Goetz, 2017; Putwain, Becker, Symes, & Pekrun, 2018). Although in CVT contextual factors and appraisals are considered antecedents of achievement emotions, which in turn are hypothesized to affect several academic outcomes, the relationship between all these components is not considered unidirectional but bidirectional. Students' achievement outcomes surely affect their emotional experiences, and both of them certainly influence students' appraisals and even contextual factors. Therefore, according to Pekrun (2006), the various components of the CVT influence each other reciprocally over time, an assumption that has been receiving empirical support (e.g., Henschel & Roick, 2017; Pekrun et al., 2014, 2017; Putwain, Becker, et al., 2018; Putwain, Pekrun, et al., 2018).

Research on achievement emotions has grown tremendously in the last decade. However, most studies have focused on the achievement emotions of university and secondary students and, to a lesser extent, of middle school students. Little is known about the emotional experiences of elementary students in academic situations. In an attempt to address this gap, Lichtenfeld, Pekrun, Stupnisky, Reiss, and Murayama (2012) developed a measurement instrument specifically designed for this age group – the Achievement Emotions Questionnaire for Elementary School (AEQ-ES).

### *Measuring the achievement emotions of elementary schoolchildren*

The AEQ-ES (Lichtenfeld et al., 2012) is based on CVT (Pekrun, 2006) and measures three achievement emotions which, according to the authors, are of primary importance and frequently experienced in achievement settings: enjoyment, anxiety, and boredom. Given the domain and context specificity of achievement emotions, the AEQ-ES measures these three emotions in the domain of mathematics in three academic settings: attending classes, doing homework, and taking tests. This questionnaire was tested using samples of German and American elementary students

in the second and third grades. The results of the CFA showed that a hierarchical model composed of eight first-order factors, representing the setting-specific emotions, and three second-order factors, representing the three emotions globally, was the solution that best fit the data. Moreover, this hierarchical structure was also found to be invariant across the German and American samples (Lichtenfeld et al., 2012). As in previous studies with older students, Lichtenfeld et al. (2012) found that enjoyment was negatively related to anxiety and boredom, and positively related to achievement. Boredom and anxiety were positively correlated with each other, and they were both negatively related to achievement. These results corroborate both the internal and external validity of the AEQ-ES, which also displayed good to excellent reliability in both German and American samples.

Recently, Raccanello et al. (2018) tested an Italian version of the AEQ-ES with a sample of second and fourth graders. The authors tested the cross-cultural invariance of the hierarchical structure of the AEQ-ES by comparing their data from a sample of Italian students with the results previously obtained by Lichtenfeld et al. (2012) from samples of German and American students. Raccanello et al. (2018) corroborated the structural invariance of the questionnaire across the three countries, as well as across gender, grades, and two domains (mathematics and native language).

In the Portuguese context, research on students' achievement emotions is just taking its first steps (e.g., Mata, Peixoto, Monteiro, & Sanches, 2017; Peixoto et al., 2017) after the adaptation of the AEQ for Portuguese pre-adolescent students (Peixoto, Mata, Monteiro, Sanches, & Pekrun, 2015). Studies of the achievement emotions of Portuguese elementary students is thus far nonexistent, and in order to reverse this situation valid and reliable measuring instruments are necessary. Therefore, the present study has two main goals: (1) to translate and adapt the AEQ-ES (Lichtenfeld et al., 2012) into the Portuguese language, and (2) to analyze the psychometric properties of the adapted version with a sample of Portuguese students.

## Method

### *Participants*

This study included a sample of 350 elementary school students, aged 7 to 12 years (52.3% male,  $M_{age}=8.81$ ,  $SD=0.79$ ), from seven public and private schools of the Lisbon area and surroundings. The sample comprised two grade groups: 226 third-graders (56.6% male,  $M_{age}=8.38$ ;  $SD=0.52$ ) and 124 fourth-graders (44.4% male,  $M_{age}=9.57$ ;  $SD=0.61$ ). For test-retest purposes, data were collected four months later from a subsample ( $n=82$ , 57% male,  $M_{age}=8.07$ ;  $SD=0.34$ ) of students who participated in a broader longitudinal research project.

### *Measures*

The original AEQ-ES was first translated into Portuguese by members of the research team fluent in English. The translated version was reviewed by a bilingual translator and then back-translated into English to ensure that the original meaning of the items had not been lost. We then proceeded to the evaluation of the face validity of the translated version. A team member conducted group interviews with 8- and 9-year-old children to ensure that the content and meaning of the items were easily understood by the children of these ages and did not generate misunderstandings or erroneous interpretations. As some items generated doubts and were not fully understood by the children, we made some adjustments to clarify their content, using terms more familiar to Portuguese children at that age, and simplifying the sentence structure. These reformulations were

made so that the new items remained equivalent to the originals from the point of view of their content/emotion addressed. All the reformulated items were then evaluated by an expert in achievement emotions to ensure that they measured the same achievement emotion as assessed by the original items (see Appendix 1).

Just like the original AEQ-ES (Lichtenfeld et al., 2012), the AEQ-ES-P is composed of 28 items measuring students' enjoyment (nine items), boredom (seven items), and anxiety (12 items) toward mathematics in three different academic settings: while attending classes (e.g., "*I find math classes so boring that I would rather do something else*"), while doing homework (e.g., "*I enjoy math homework so much that I don't want to stop doing it*"), and while taking tests (e.g., "*I get very nervous during math tests*"). Boredom is only measured in class and homework settings since, according to the authors, this is not an emotion typically experienced while taking tests (Lichtenfeld et al., 2012). The questionnaire is therefore composed of eight setting-specific scales, resulting from the combination of the three achievement emotions and the different academic settings in which they are usually experienced (the complete list of the items is provided in Appendix 1). Items are answered on a 5-point pictorial rating scale (1=not at all; 5=very much), anchored by graphical representations of faces showing various levels of emotional intensity. Therefore, the questionnaire has two versions: one for male students (with boys' faces) and another for female students (with girls' faces), just as in the original AEQ-ES (see Lichtenfeld et al., 2012).

To examine the external validity of the scale, two additional measures were included: perceived competence and motivational orientations. Perceived competence in mathematics was measured through the Math Competence Perception Scale (EPCM: Santos, Mata, Monteiro, Sanches, & Gomes, 2018), which is composed of five items (e.g., "*I am good in Math*") answered on a 5-point Likert scale (1=never; 5=always). Students' Motivational Orientations were measured using a Portuguese version of the Academic Self-Regulation Questionnaire (SRQ-A; Gomes, Monteiro, Mata, Santos, & Sanches, 2018), which is grounded on Self-Determination Theory (SDT; Deci & Ryan, 2000; Ryan & Connell, 1989). This questionnaire comprises 24 items measuring four motivational orientations proposed by SDT, which correspond to four regulatory styles: External regulation (e.g., "*I do my math homework because I don't want to be punished*"), introjected regulation (e.g., "*I do my math homework because I want the teacher to think I'm a good student*"), identified regulation (e.g., "*I do my math homework because it's important to me to do my math homework*"), and intrinsic regulation (e.g., "*I do my math homework because I enjoy doing it*"). Answers to this questionnaire are given on a 5-point Likert scale (1=never; 5=always). From the scores obtained for the four regulatory styles it is possible to calculate the relative autonomy index (RAI) for each of the participants (for instructions on how to calculate the RAI see Deci & Ryan, 2000; Ryan & Connell, 1989). The more positive the RAI, the more autonomous the regulation and the more intrinsic the motivational orientation, while the more negative the RAI, the more controlled the regulation and the more extrinsic the motivational orientation.

### *Procedures*

This study is part of a broader research project approved by the Research Ethics Committee of the authors' research center, the Portuguese Ministry of Education (DGE), and the National Commission for Data Protection (CNPD). After obtaining the consent of the school boards, written consent was obtained from the parents. Confidentiality of the data collected was guaranteed and student participation was voluntary. All measures were administered at once during regular classroom hours in the exclusive presence of trained assistants, and the process lasted between 30 and 40 minutes. Students were told that there were no "right" or "wrong" answers to this questionnaire. The items were read aloud to avoid misinterpretation resulting from possible reading difficulties. Three sample items unrelated to the school setting, one for each emotion, were also

added so that students could train and become familiar with how to answer the questionnaire. The same questionnaire was administered to a subsample ( $n=82$ ) of the initial 350 participants four months later following the same procedures.

## Results

### Factor structure

We tested the factor structure of the AEQ-ES-P according to the model proposed by Lichtenfeld et al. (2012). This model postulates a hierarchical structure with eight latent first-order factors that correspond to the eight scales of the AEQ-ES-P measuring the three emotions experienced in each academic setting (class, homework, and tests). It also posits three latent second-order factors corresponding to the three global achievement emotions of enjoyment, boredom, and anxiety (Figure 1). Also following the method used both by Lichtenfeld et al. (2012) and Raccanello et al. (2018), we conducted confirmatory factor analysis (CFA) using the maximum likelihood estimation method, as available in AMOS 24.0. The results of the CFA indicated that this model adequately fits the data ( $\chi^2(340)=929.59, p<.001$ ; CFI=.91; TLI=.90; RMSEA=.070, 90IC=[.065; .076],  $p<.001$ ), according to the criteria suggested by Hair, William, Barry, Rolph, and Ronald (2010) and Kline (2011). All items displayed factor loadings higher than .50 except item eight of the scale homework anxiety, which was, however, retained since its removal did not improve the model fit or the reliability of the scales.

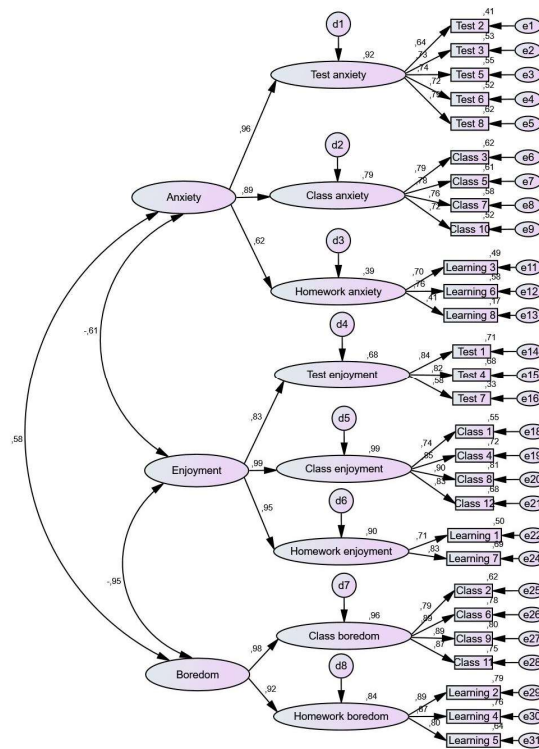


Figure 1. Confirmatory Factor Analysis of the AEQ-ES-P, adjusted to a sample of 350 students  
 Note.  $\chi^2(340)=929.59, p<.001$ ; CFI=.91; TLI=.90; RMSEA=.070, 90 IC=[.065; .076],  $p<.001$ ).

### Convergent and discriminant validity

We analyzed the convergent validity of the scale by calculating the average variance extracted (AVE), whose values are considered adequate when higher than .50 (Hair et al., 2010). Adequate values of AVE were found for anxiety (.70), enjoyment (.86), and boredom (.90). Discriminant validity was analyzed by comparing the AVE scores with the maximum shared squared variance (MSV) and the average squared variance (ASV), whose values should be lower than those of the AVE. While the ASV values were lower than those of the AVE for the three achievement emotions ( $ASV_{Anxiety}=.35$ ;  $ASV_{Enjoyment}=.64$ ;  $ASV_{Boredom}=.63$ ), the MSV values were lower than those of the AVE for anxiety ( $MSV=.38$ ), equal for boredom ( $MSV=.90$ ), and higher for enjoyment ( $MSV=.90$ ). These results support the convergent validity of the AEQ-ES-P, but its discriminant validity is somewhat compromised due to the weak discrimination between the boredom and enjoyment scales.

### Item statistics and reliability

Descriptive statistics of the AEQ-ES-P scales are shown in Table 1. The distribution of the answers on all of the eight scales covered the possible range of the scale, indicating that children of the third and fourth grades are able to distinguish between these three emotions in different academic settings (classes, homework, and tests). Boredom, both global and setting-specific, as well as class anxiety, presented positively asymmetric distributions, indicating that these achievement emotions are not common among third and fourth graders in the domain of mathematics. Indeed, when we look at the mean values of the eight scales, we can clearly see that boredom was the emotion least reported by students and enjoyment the most.

Table 1

*Descriptive statistics of the AEQ-ES-P scales*

Scale	Number of items	Possible range	Observed range	<i>M</i>	<i>SD</i>	<i>Sk</i>	<i>Ku</i>	$\alpha$	<i>CR</i>	Test-retest
Anxiety	12	1-5	1-4.93	2.39	0.83	0.38	-0.45	.89	.87	.59***
Test anxiety	5	1-5	1-5	2.57	0.99	0.31	-0.81	.84	.85	.52***
Class anxiety	4	1-5	1-5	2.17	0.95	0.82	0.08	.84	.85	.55***
Homework anxiety	3	1-5	1-5	2.43	0.98	0.34	-0.56	.62	.67	.41***
Enjoyment	9	1-5	1-5	3.58	1.02	-0.42	-0.72	.92	.95	.67***
Test enjoyment	3	1-5	1-5	3.47	1.13	-0.30	-0.91	.79	.80	.61***
Class enjoyment	4	1-5	1-5	3.70	1.13	-0.56	-0.71	.89	.90	.63***
Homework enjoyment	2	1-5	1-5	3.56	1.14	-0.42	-0.62	.74	.75	.45***
Boredom	7	1-5	1-5	2.09	1.12	0.99	0.05	.94	.95	.58***
Class boredom	4	1-5	1-5	2.17	1.22	0.94	0.13	.92	.94	.55***
Homework boredom	3	1-5	1-5	2.01	1.13	1.05	-0.15	.89	.89	.41***

Note. \*\*\*= $p<.001$ ; *Sk*=skewness; *Ku*=kurtosis;  $\alpha$ =Cronbach's alpha; *CR*=composite reliability.

To examine the reliability of the scale, we calculated Cronbach's alpha coefficients ( $\alpha$ ) and composite reliability (*CR*), where values higher than .70 are considered adequate (Hair et al., 2010). As can be observed in Table 1, both Cronbach's alpha and *CR* displayed values higher than .80 on most scales. Only one scale, homework anxiety, displayed reliability scores below .70, which, however, exceeds the minimal acceptable value of .60 (Loewenthal, 2004). The global scales (enjoyment, boredom, and anxiety) presented better reliability indices than the scales measuring the

achievement emotions in specific academic settings. However, all the reliability scores were between acceptable and excellent, demonstrating the internal consistency of the AEQ-ES-P.

We examined the temporal stability of the instrument using test-retest Pearson correlations with a four-month interval calculated only for a sub-sample of participants ( $n=82$ ) who were part of a broader longitudinal study. The four-month test-retest correlations were moderate in size ( $r=[.41-.67]$ ), indicating that all the scales were relatively stable, with the homework scales being the least stable.

### Internal validity

Table 2 presents Pearson correlation coefficients between the global scales, as well as between the scales measuring the emotions in different academic settings. At the level of the global scales, we observed that enjoyment, a positive valence emotion, was negatively correlated with both anxiety and boredom, negative valence emotions. These two negative emotions were in turn positively correlated with each other.

Table 2

*Manifest correlations of the AEQ-ES-P scales, perceived competence, and motivational orientations*

Scale	1	2	3	4	5	6	7	8	9	10	RAI	PC
1. Anxiety	1										-.25	-.60
2. Test anxiety	.88	1									-.24	-.60
3. Class anxiety	.87	.72	1								-.34	-.54
4. Homework anxiety	.81	.55	.53	1							-.07 <sup>a</sup>	-.34
5. Enjoyment	-.53	-.57	-.51	-.28	1						.49	.64
6. Test enjoyment	-.51	-.59	-.47	-.26	.88	1					.36	.62
7. Class enjoyment	-.47	-.50	-.49	-.21	.92	.71	1				.54	.59
8. Homework enjoyment	-.45	-.45	-.42	-.28	.90	.66	.77	1			.42	.51
9. Boredom	.48	.50	.47	.26	-.83	-.61	-.85	-.77	1		-.52	-.51
10. Class boredom	.47	.49	.48	.23	-.81	-.61	-.86	-.70	.95	1	-.53	-.51
11. Homework boredom	.45	.47	.42	.27	-.77	-.56	-.76	-.76	.95	.81	-.45	-.60

Note. RAI=Relative Autonomy Index; PC=Perceived Competence. All correlation coefficients were significant ( $p<.001$ ) except <sup>a</sup> ( $p>.050$ ).

At the setting-specific level, correlations followed the same pattern: students' reported enjoyment in class, homework, and test settings was negatively correlated with both anxiety and boredom in those three settings. Negative valence emotions experienced in different academic settings were in turn positively correlated. These correlations seem to corroborate the internal validity of the instrument.

### External validity

In order to examine the external validity of the AEQ-ES-P, we calculated Pearson correlation coefficients between the achievement emotions, perceived competence, and motivational orientations reported by elementary students in the domain of mathematics (Table 2). Enjoyment was found to be positively associated with perceived competence, while anxiety and boredom were negatively associated with students' competence perception in math. A similar pattern of results was found for motivational orientations. Enjoyment was positively related to the students' RAI, while anxiety and boredom were negatively related. This indicates that the more intrinsic the students' motivational orientations (that is, the more autonomously regulated and less

controlled), the more they report enjoyment and the less they report anxiety and boredom toward math activities. These results highlight the link between achievement emotions, students' perceived competence, and their motivational orientations in the domain of mathematics.

### Measurement invariance

We tested the invariance of the measurement model by gender and school grade to ensure that the factor structure of AEQ-ES-P was equivalent for boys and girls and for third and fourth graders. In both cases, we evaluated invariance by comparing a free model (with freely estimated factor loadings, intercepts, and covariance of factors) with constrained models where factor loadings ( $\lambda$ ), intercepts ( $i$ ), and covariances were fixed. Significant changes were monitored by differences in chi-square values ( $\Delta\chi^2$ ) as well as by changes in CFI ( $\Delta CFI$ ), given that  $\Delta\chi^2$  is sensitive to sample size (Cheung & Rensvold, 2002). The model is considered invariant when  $\Delta\chi^2$  values are non-significant ( $p \geq .05$ ), or instead when  $\Delta CFI$  values are lower than .01.

Table 3 presents the results of the invariance tests of the AEQ-ES-P. Although we found significant differences in chi-square values for some of the compared models, the results confirmed the invariance of the structural models for both gender and grade, since in both cases the adjustment of the data continued to be adequate in the model with free parameters (configurational invariance) and the values of  $\Delta CFI$  were always lower than .01. These results indicate that the AEQ-ES-P evaluated the same constructs in boys and girls and in students of the third and fourth grades.

Table 3

*Invariance tests of the structural model by gender and school grade*

	Model	$\chi^2$	df	p	CFI	RMSEA	$\Delta\chi^2$	df	p	$\Delta CFI$
Gender	Configural invariance	1338.06	672	<.001	.906	.053	–	–	–	–
	Metric invariance	1375.05	692	<.001	.903	.053	36.99	20	.012	.003
	Scalar invariance	1421.60	720	<.001	.901	.053	46.55	28	.015	.002
	Invariance of factors	1424.14	725	<.001	.901	.053	2.54	5	.771	.002
	Invariance of factor covariances	1435.14	731	<.001	.900	.053	11.00	6	.088	.001
School grade	Configural invariance	1263.15	672	<.001	.915	.050	–	–	–	–
	Metric invariance	1294.78	692	<.001	.914	.050	31.63	20	.047	.001
	Scalar invariance	1379.41	720	<.001	.906	.051	84.64	28	<.001	.008
	Invariance of factors	1385.92	725	<.001	.906	.051	6.51	5	.260	<.001
	Invariance of factor covariances	1410.97	731	<.001	.901	.052	25.05	6	<.001	.005

Note.  $N_{boys}=183$ ;  $N_{girls}=167$ ;  $N_{3^{rd}}=226$ ;  $N_{4^{th}}=124$ .  $\chi^2$ =chi-square;  $df$ =degrees of freedom;  $CFI$ =comparative-fit index;  $RMSEA$ =root mean square error of approximation;  $\Delta\chi^2$ =chi-square difference;  $\Delta CFI$ =comparative-fit index difference.

### Gender and school grade differences

Once the invariance of the model was shown for gender and school grade, we examined whether there were significant differences in students' emotions toward mathematics by these two variables (Table 4). The results of Student's *t*-test showed significant gender differences in anxiety and enjoyment, although these effects were small to moderate. Girls reported more anxiety than boys towards math, both in general and in setting-specific situations, and less enjoyment in test situations. The results also suggest the existence of differences between girls and boys in general enjoyment, with girls reporting lower levels thereof, although this difference is only marginally significant and the magnitude of the effect is small.



**Table 4**  
*Descriptive statistics of the AEQ-ES-P scales by gender and school grade*

Scale	Gender					School grade				
	<i>M</i> ( <i>SD</i> ) Boys	<i>M</i> ( <i>SD</i> ) Girls	<i>t</i> (348)	<i>p</i>	<i>d</i>	<i>M</i> ( <i>SD</i> ) 3 <sup>rd</sup>	<i>M</i> ( <i>SD</i> ) 4 <sup>th</sup>	<i>t</i> (348)	<i>p</i>	<i>d</i>
Anxiety	2.27(0.85)	2.52 (0.79)	-2.87	.004	-0.31	2.30 (0.81)	2.55 (0.86)	-2.76	.006	-0.31
Test anxiety	2.44 (0.99)	2.70 (0.98)	-2.47	.014	-0.27	2.42 (0.92)	2.83 (1.05)	-3.67	<.001	-0.41
Class anxiety	2.06 (0.97)	2.29 (0.92)	-2.30	.022	-0.25	2.09 (0.91)	2.30 (1.01)	-1.95	.051	-0.22
Homework anxiety	2.30 (0.99)	2.57 (0.94)	-2.59	.010	-0.28	2.37 (0.96)	2.52 (1.01)	-1.31	.191	-0.15
Enjoyment	3.67 (1.05)	3.47 (0.98)	1.82	.070	0.20	3.70 (1.02)	3.36 (0.98)	2.96	.003	0.33
Test enjoyment	3.62 (1.14)	3.29 (1.09)	2.74	.007	0.29	3.64 (1.08)	3.15 (1.15)	3.96	<.001	0.44
Class enjoyment	3.79 (1.15)	3.61 (1.11)	1.53	.127	0.16	3.77 (1.14)	3.59 (1.11)	1.39	.166	0.16
Homework enjoyment	3.60 (1.11)	3.52 (1.13)	0.68	.500	0.07	3.68 (1.18)	3.34 (1.05)	2.65	.008	0.30
Boredom	2.07 (1.15)	2.12 (1.09)	-0.48	.632	-0.05	2.07 (1.11)	2.14 (1.13)	-0.57	.569	-0.06
Class boredom	1.96 (1.14)	2.07 (1.12)	-0.90	.371	-0.10	1.99 (1.12)	2.06 (1.16)	-0.60	.546	-0.07
Homework boredom	2.17 (1.27)	2.18 (1.16)	-0.05	.962	-0.01	2.15 (1.23)	2.21 (1.20)	-0.48	.628	-0.05

Note.  $N_{boys}=183$ ;  $N_{girls}=167$ ;  $N_{3^{rd}}=226$ ;  $N_{4^{th}}=124$ .  $t=t$ -student;  $d=Cohen's d$ .

Regarding school grade, the results of the  $t$ -tests showed significant moderate differences between third and fourth graders, once again for anxiety and enjoyment. Overall, fourth graders reported feeling more anxiety and less enjoyment toward math than third graders. No significant differences were found between students from the third and fourth grades on reported boredom, classroom enjoyment, or homework anxiety.

## Discussion

The current study aimed to translate and adapt the AEQ-ES (Lichtenfeld et al., 2012) into Portuguese and to analyze its psychometric properties. The results of the CFA confirmed the hierarchical structure proposed by Lichtenfeld et al. (2012), and also obtained in a recent AEQ-ES validation study conducted by Raccanello et al. (2018). These results indicate that elementary school students are able to differentiate between the feelings of enjoyment, anxiety, and boredom experienced in different academic settings, such as when attending classes, doing homework, or taking tests. The invariance tests further showed that the AEQ-ES-P evaluates the same constructs across genders and grades. It is therefore a suitable instrument to measure the enjoyment, anxiety, and boredom experienced by boys and girls and by students of the third and fourth grades in math achievement situations.

The reliability of the AEQ-ES-P was supported by the good internal consistency scores, which were similar to those obtained by Lichtenfeld et al. (2012) and Raccanello et al. (2018), as well as by the temporal stability observed. Although the convergent validity of the AEQ-ES-P was confirmed, its discriminant validity was slightly compromised, given the strong associations between the enjoyment and boredom scales. However, the manifest correlations reported in the studies of Lichtenfeld et al. (2012) and Raccanello et al. (2018) between the setting-specific enjoyment and boredom scales are similar to those obtained in the present study, particularly those reported by Raccanello et al. (2018). These high correlations seem to suggest that these two emotions are considered by children as two opposite poles of an emotional continuum between enjoyment and boredom. It is nonetheless possible that these results are partly due to the method of analysis used, since in CFA the correlations between factors tend to be positively skewed (Marsh, Morin, Parker, & Kaur, 2014).

The internal validity of the AEQ-ES-P was supported by the pattern of correlations obtained between all the emotion scales, both global and setting-specific: enjoyment was negatively correlated

with anxiety and boredom, which were positively correlated with each other. This pattern was consistent with that found by Lichtenfeld et al. (2012) and Raccanello et al. (2018), as well as with the results obtained in recent studies using elementary school students (e.g., Pekrun et al., 2017).

The external validity of the instrument was evidenced through the correlations obtained between achievement emotions, competence perceptions, and students' motivational orientations. As in previous studies with elementary students, we found that perceived competence, a control appraisal, was positively associated with enjoyment and negatively associated with anxiety and boredom (e.g., Henschel & Roick, 2017; Lauermaun et al., 2017; Lichtenfeld et al., 2012; Pekrun et al., 2017; Putwain, Pekrun, et al., 2018; Raccanello et al., 2018). Regarding the association between achievement emotions and motivational orientations, our results showed that a more intrinsic motivational orientation, which corresponds to a more autonomous regulation, was positively associated with enjoyment and negatively associated with boredom and anxiety. These findings align with those of previous studies conducted both with older students (e.g., González, Paoloni, & Rinaudo, 2013; Mouratidis & Michou, 2011; Pekrun et al., 2010) and with elementary students (e.g., Obergriesser & Stoeger, 2016). Finally, we found some gender and grade differences among Portuguese elementary students similar to those reported in previous studies that included students of these ages (e.g., Lichtenfeld et al., 2012; Lohbeck et al., 2016; Raccanello, Brondino, & De Bernardi, 2013; Raccanello et al., 2018; Vierhaus, Lohaus, & Wild, 2016), and even in studies of Portuguese students from fifth grade on (Mata et al., 2017). Although the differences were small to moderate in size, our results generally point to the same negative emotional pattern found in the aforementioned studies: girls and fourth graders report less enjoyment and more anxiety towards mathematics than boys and third graders. As with Raccanello et al. (2018), no significant gender and grade differences were found regarding boredom in mathematics.

In order to overcome some of the limitations of the current study, future research should examine the discriminant validity of the instrument regarding enjoyment and boredom in greater depth, for example using Exploratory Structural Equation Modeling (ESEM), as recommended by Marsh et al. (2014). Since the AEQ-ES\_P is a self-report instrument, it is also important for future studies to complement the data provided by Portuguese students with data provided by their teachers. Data on students' academic achievement and other academic outcomes should also be gathered, and their reciprocal relationship with emotions should be examined longitudinally. Further, students' achievement emotions in different academic domains and in earlier grades should also be explored. Given the strong associations between students' emotional experiences, their control and value appraisals, and several academic outcomes (e.g., Pekrun et al., 2010, 2017; Putwain, Becker, et al., 2018; Putwain, Pekrun, et al., 2018), our results highlight the importance of studying achievement emotions as soon as students enter formal schooling. The sooner negative emotional patterns are identified, the greater the likelihood of an intervention to be effective in breaking down these cycles or, ideally, in preventing them from even forming. A first step in that direction is to develop reliable and valid instruments specific to this age group, which was the main contribution we intended to make in the current study. Our findings show that the AEQ-ES-P has good psychometric properties and support the validity and adequacy of this instrument to measure Portuguese elementary students' achievement emotions in the domain of mathematics.

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## Appendix 1

### Items of the AEQ-ES-P (female version)

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#### Sala de aula

1. Eu gosto da aula de matemática.
2. A aula de matemática aborrece-me.
3. Fico nervosa quando o(a) professor(a) me faz perguntas na aula de matemática.
4. Eu estou desejosa de ir para a aula de matemática.
5. Fico nervosa na aula de matemática.
6. A aula de matemática para mim é chata.
7. Quando penso na aula de matemática, fico aflita.
8. A aula de matemática para mim é divertida.
9. Eu acho que fazer exercícios de matemática é “uma seca”.
10. Na aula de matemática, fico preocupada que as coisas sejam difíceis para mim.
11. Eu acho a aula de matemática tão aborrecida que preferia fazer outra coisa qualquer.
12. Eu gosto de fazer atividades de matemática.

#### Trabalhos de casa

1. Quando faço os trabalhos de casa de matemática, estou bem-disposta.
2. Os trabalhos de casa de matemática para mim são “uma seca”.
3. Fico preocupada se não sou capaz de fazer os trabalhos de casa de matemática.
4. Acho os trabalhos de casa de matemática tão chatos que não me apetece fazê-los.
5. Quando faço os trabalhos de casa de matemática, farto-me rapidamente.
6. Fico aflita quando não percebo os trabalhos de casa de matemática.
7. Eu gosto tanto dos trabalhos de casa de matemática que não quero parar de os fazer.
8. Fico tão nervosa quando tenho de fazer os trabalhos de casa de matemática que não me apetece começar a fazê-los.

#### Testes

1. Eu gosto de fazer os testes de matemática.
  2. Quando faço testes de matemática, fico com medo de ter uma má nota.
  3. Fico tão nervosa durante os testes de matemática que não me consigo lembrar bem do que aprendi.
  4. Fico desejosa de fazer os testes de matemática.
  5. Os testes de matemática assustam-me tanto que preferia não os fazer.
  6. Fico tão nervosa durante os testes de matemática que não me consigo concentrar bem.
  7. Durante os testes de matemática, eu penso: “Isto está a correr muito bem!”.
  8. Fico muito nervosa durante os testes de matemática.
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### Propriedades psicométricas da versão portuguesa do Achievement Emotions Questionnaire para o 1º ciclo

Os principais objetivos do corrente estudo consistiram na tradução e adaptação do Achievement Emotions Questionnaire – Elementary School (AEQ-ES) para Português e na análise das suas propriedades psicométricas. Uma amostra de 350 alunos portugueses do terceiro e quarto ano de escolaridade (com idades compreendidas entre os 7 e os 12 anos) completou a versão portuguesa do AEQ-ES (AEQ-ES-P). Tal como a versão original, o AEQ-ES-P mede o prazer, o aborrecimento e a ansiedade dos alunos em relação à matemática em três contextos académicos: assistir a aulas, fazer os trabalhos de casa e fazer testes. A análise fatorial confirmatória corroborou a estrutura hierárquica do AEQ-ES-P, que também se mostrou invariante entre géneros e anos de escolaridade. O instrumento mostrou também boa fiabilidade e estabilidade temporal. Foram encontradas correlações significativas na direção esperada entre o prazer, a ansiedade e o aborrecimento, bem como entre essas emoções, as percepções de competência dos alunos e a sua motivação intrínseca para a matemática, apoiando assim a validade interna e externa do questionário. Estes resultados indicam que o AEQ-ES-P apresenta boas propriedades psicométricas e é adequado para medir as emoções de realização de crianças portuguesas do terceiro e do quarto ano de escolaridade no domínio da matemática.

**Palavras-chave:** Emoções de realização; Ansiedade, Aborrecimento, Prazer, Alunos do 1º ciclo.

