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Portuguese Validation of the Climate Change Attitude Survey: Psychometric Properties and Relations with Positive Youth Development

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ABSTRACT
Promoting positive development may lead to young people's active contributions to their environment through positive attitudes and behaviours. The Climate Change Attitude Survey (15-item version) aims to identify climate change attitudes differences in groups of students and to assess pre- to post-intervention attitude changes. We intended to validate and test a possible extension of this scale among a Portuguese sample of adolescents and emerging adults. We also investigated whether higher scores on this scale would be positively associated with positive youth development. Exploratory and confirmatory factor analysis, measurement invariance, and convergent validity were assessed. The results showed good psychometric properties aligned with the original factorial structure. Significant differences were found among female and male samples regarding beliefs and intentions. A small but significant positive association was identified with a positive youth development scale. We suggest this may be an adequate instrument to assess youth climate change beliefs and intentions.

How youth relate to climate change is becoming a compelling field of research for developmental psychologists (Ojala, 2022). Evidence points to youth's increased vulnerability to climate change impacts but also their potential to act as agents of change (Sanson et al., 2018). Due to the maturational process adolescents and emerging adults undergo, opportunities for learning and making impactful decisions should be enhanced (Sawyer et al., 2018).

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Positive Youth Development (PYD) is a strength-based theory that holds that positive outcomes result from the alignment of youth individual and environmental assets (Gomez-Baya et al., 2020). Ardoin et al. (2022) argue that environmental education's goal of promoting environmental literacy and action towards the well-being of the environment mirrors the idea of contribution from the 5Cs model of PYD (e.g., Bowers et al., 2010). According to this model, thriving youth's actions and other-oriented ideology may enhance their communities and possibly the natural environment. Thus, researchers are at the onset of analysing associations between PYD and environmental dimensions. For instance, Bøhlerengen and Wiium's (2022) results suggest that experiencing the 5Cs can enable youth to contribute actively to the environment through positive attitudes and behaviours.

Attitudes and attitude change are of particular concern in climate change education research (Albarracin & Shavitt, 2018). The Climate Change Attitude Survey (CCAS), proposed by Christensen and Knezek (2015), is a 15-item scale designed to identify students' climate change attitude differences and assess pre- to post-intervention attitude changes. The authors targeted the measurement of a) beliefs, defined as the acceptance of attitudes towards climate change, and b) intentions, representing the willingness to act. An additional goal was to go beyond the focus of existing scales in adult samples and general environmental attitudes.

We aimed to validate the CCAS among a sample of Portuguese adolescents and emerging adults. Ethical approval from the University of Minho's Ethics Committee for Research in Social and Human Sciences (CEICSH 090/2020) was obtained. Following the suggestion from the original study (Christensen & Knezek, 2015), an exploratory analysis testing the possibility of including new items was first performed. These authors hypothesized that additional constructs might emerge. Given the unsatisfactory results, we restrained the analysis of the scale's psychometric properties to the 15-item original version. We also tested for measurement invariance and convergent validity with a measure of PYD. To the best of our knowledge, this is the first validation study of the CCAS in a different language.

Materials and method

Participants

A total of 499 adolescents (31.46% males; 68.54% females) aged between 16 and 24 ($M = 19.38$; SD = 2.28) was included in the study. Most of them perceived their academic achievement to be on average (77.96%) and reported being from a middle-class background (83.57%). They mostly reported attending secondary school (46.09%) and the university (43.29%). Most participants identified as not being part of any project or organization related to climate action (92.79%) and not having attended any related training or awareness initiative (71.94%).

Measures

Sociodemographic questionnaire
The research team developed a brief questionnaire regarding sociodemographic information.

Climate change attitudes
The Climate Change Attitude Survey (CCAS, Christensen & Knezek, 2015; Questionário de Atitudes face às Alterações Climáticas, Portuguese translation) is a self-report instrument with 15 items designed to measure students' beliefs and intentions towards climate change. It is rated on a Likert-scale (1=strongly disagree; 2=disagree; 3=undecided; 4=agree; 5=strongly disagree). Items 9, 12, 13, 14, and 15 are reversed. Perceived beliefs about climate change and the environment are measured by items 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, and intentions to make a difference in climate change are evaluated by items 9, 12, 13, 14, 15. Higher total scores represent stronger intentions and beliefs regarding climate change. The original scale (Christensen & Knezek, 2015) presents a Cronbach's alpha of $\alpha = .72$, and the subscales ranged between $\alpha = .70$ (intentions) and $\alpha = .87$ (beliefs). In this study, we obtained a Cronbach's alpha of $\alpha = .93$, and for each subscale, the values ranged between $\alpha = .88$ (intentions) and $\alpha = .94$ (beliefs).

Positive youth development
The Positive Youth Development Short Form (PYD-SF, Geldhof et al., 2014; Tomé et al., 2019) assesses the individual global level of PYD based on the Five C's Model of PYD, one of the most prominent frameworks in this field of research (e.g., Bowers et al., 2010). It comprises 34 items and 5 subscales representing the five Cs of this model: competence, confidence,

character, caring, and connection. The items are rated on varied Likert Scales from 1 to 5. The Portuguese validation has shown that Cronbach's alpha ranged between α = .73 and α = .87 (Tomé et al., 2019). In this study, Cronbach's alpha ranged between α = .73 and α = .84.

Procedure

Sampling and scaling procedures

The original instrument was translated into Portuguese and backtranslated. Three items suggested in the original paper discussion section were added to the 15-item version, namely: 'I believe that I can contribute to the solutions of environmental problems by my actions' (Champeau, 1997), 'Environmental problems can be solved without big changes to our way of life', and 'I think each of us can make a significant contribution to environmental protection' (Le Hebel et al., 2014). Qualtrics platform allowed online distribution and counterbalancing the order of instruments. Participants were recruited using a convenience sampling technique. The study was disseminated through social networks and email contacts with national youth associations, schools, and universities.

Statistical procedures

We used Principal Components Analysis with Parallel Analysis (Lim & Jahng, 2019) on the 18-item scale to reduce dimensionality of the data. Then, we conducted Exploratory Factorial Analysis (EFA) to explore the factorial structure of this version. Following the suggestion of the authors of the original scale, extraction was performed with Varimax rotation. Given the results of the 18-item version, as will be further explained, we proceeded with the validation analyses on the 15-item version of the scale.

First, we generated descriptive statistics. Reliability analysis for each subscale was conducted through IBM SPSS Statistics 27, assessing the Cronbach alpha. We then tested for construct validity, using IBM SPSS AMOS 27 to perform Confirmatory Factor Analysis (CFA) using the maximum likelihood estimator. According to Tabachnick and Fidell (2013), deviation from normality does not make a substantive difference in the analysis in large samples. These analyses considered the Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) > 0.95, the Root Mean Square Error of Approximation (RMSEA) < 0.6, and the Standardized Root Mean Square Residual (SRMR) < 0.08 (Hu & Bentler, 1999).

To test measurement invariance considering assigned sex (male and female) and age range (16–18, 19–21, 22–24), we performed a multiple-group CFA (MGCFA) using AMOS. We conducted hierarchically ordered steps to assess configural, metric, and scalar invariance (Vandenberg & Lance, 2000). Given the sample size (≥300), we considered that a change of ≥-.010 in CFI (Δ CFI), supplemented by a change of ≥ .015 in RMSEA (Δ RMSEA), would be an indication of non-invariance (Chen, 2007).

Pearson correlations between CCAS and PYD-SF were performed to test the convergent validity. Given the violation of the normality assumption in our data, we conducted the Mann-Whitney test using SPSS to examine assigned sex differences regarding climate change attitudes.

Results

Exploratory analysis of an extended version of the CCAS

No missing data were identified. Principal Components Analysis based on Eigenvalues and Parallel Analysis revealed that three components accounted for 66.98% of the common variance. As shown in Table 1, through EFA using Principal Axis Factoring, three factors were identified

Table 1. Factor loadings for the CCAS 18-items version.

| Item | 18-items version CCAS | | |
| | 3 Factors[a] | | |
	1	2	3
Item 1	.669		
Item 2	.764		
Item 3	.832		
Item 4	.714		
Item 5	.809		
Item 6	.584		.467
Item 7	.767		
Item 8	.737		
Item 9		.678	
Item 10	.589		.497
Item 11	.639		.312
Item 12	.336	.693	
Item 13		.700	
Item 14		.809	
Item 15		.746	.301
Item 16	.387		.704
Item 17			
Item 18	.428		.646

Note. The extraction method was Principal Axis Factoring with a Varimax with Kaiser Normalization.
[a]Rotation converged in five iterations.

with a similar distribution to the original factorial structure regarding factors 1 and 2. Factor 3 contained two of the added items (16 and 18). Item 17 absolute value was below the cut-off criteria of .30. Thus, factor 3 contains less than three items, insufficient to explain a latent construct (Hair et al., 2010). Considering these unsatisfactory results for the proposed extended version of CCAS, the following analyses are focused on the 15-item original scale.

Descriptive statistics

Table 2 shows the means and standard deviations for both beliefs and intentions subscales of CCAS, according to assigned sex and age range. Item mean scores denote that participants reported slightly higher values on beliefs than on intentions. Overall, the scale reveals strong beliefs and intentions regarding climate change.

Reliability

We obtained a Cronbach alpha of .94 for beliefs and .88 for intentions concerning the total sample (see Table 2). These values correspond to a very good level of reliability (DeVellis, 1991). When considering subgroups samples, alpha coefficients were higher for beliefs than intentions.

Construct validity

CFA revealed that some indices had a poor fit to the data, CFI = .950, TLI = .942, RMSEA = .074, SRMR = .038. No item removal was suggested. We progressively added six constraints based on modification indices for covariance to correlate the measurement errors of some items (see

Table 2. Descriptive statistics and reliability for the CCAS (15-item version).

Subscales		Beliefs (10 items)					Intentions (5 items)				
Demographic groups		Total score Mean	Total score SD	Item Mean	Item SD	α	Total score Mean	Total score SD	Item Mean	Item SD	α
Assigned sex	Female	44.74	5.51	4.47	0.55	.93	18.36	2.61	4.19	0.76	.86
	Male	42.22	6.94	4.22	0.69	.95	16.77	3.18	3.75	0.94	.89
Age range	16–18	42.25	7.30	4.22	0.73	.95	16.82	3.22	3.78	0.99	.90
	19–21	44.95	4.74	4.49	0.47	.89	18.39	2.40	4.18	0.66	.81
	22–24	45.98	3.80	4.60	0.38	.88	19.21	1.90	4.42	0.53	.74
Total		43.95	6.10	4.39	0.61	.94	17.86	2.89	4.05	0.85	.88

Note. α=Cronbach alpha; SD=Standard Deviation; Items Likert scale: 1–5
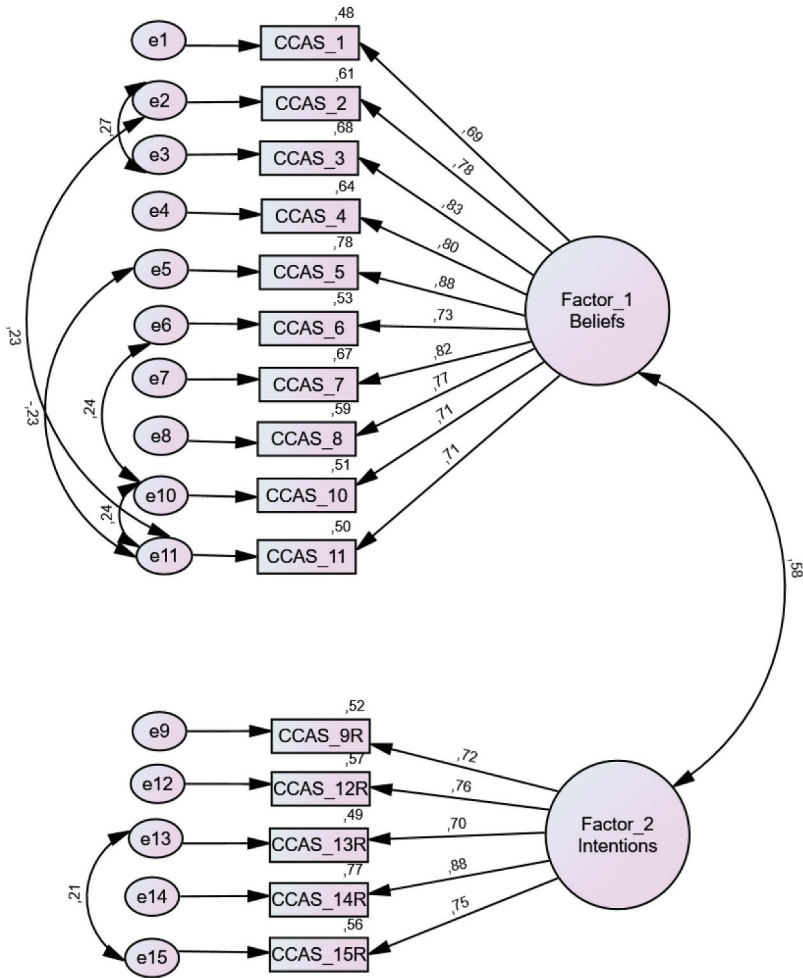
Figure 1. Path diagram of the two-factor confirmatory factor analysis of the 15-item CCAS (model 2).

Figure 1). Item meaning similarities consubstantiate the need for these correlations (Bandalos, 2021). Results of this second model demonstrated a good fit to the data for all analysed fit indices, CFI = .981, TLI = .976, RMSEA = .047, SRMR = .031.

Measurement invariance

Before conducting MGCFA, the double-factor structure of the CCAS was fitted separately for each sample. Adequate model fit indicators were found except for the above RMSEA cut-off criteria values regarding the

Table 3. Levels of measurement invariance by assigned sex and age range.

	Assigned Sex[a]			
	RMSEA	Δ RMSEA	CFI	Δ CFI
Configural invariance	.038		.975	
Metric invariance	.037	−.001	.975	0
Scalar invariance	.041	.004	.965	−.010
	Age Range[b]			
	RMSEA	Δ RMSEA	CFI	Δ CFI
Configural invariance	.038		.960	
Metric invariance	.037	−.001	.958	−.002
Scalar invariance	.042	.005	.940	−.018
Partial Scalar invariance[c]	.040	.002	.948	−.008

Note. RMSEA=root mean square error of approximation; CFI=comparative fit index. Model fit confirmed if CFI > .90 and RMSEA < .06; cut-off values for measurement invariance are Δ CFI ≤-.010 and Δ RMSEA ≤ .015 (Chen, 2007).
[a]Female ($n = 342$) and male ($n = 157$) [b]16–18 years-old ($n = 228$), 19–21 years old ($n = 158$), 22–24 years-old ($n = 113$) [c] Intercepts of items 12, 13, 14 and 15 not constrained
*$p < 0.01$.

age ranges 19–21 (CFI=.922, TLI = 901, RMSEA = .083, SRMR = .064) and 22–24 (CFI=.922, TLI=, RMSEA = .075, SRMR = .067).

Table 3 presents the fit indices for the models used within MGCFA. Considering assigned sex, acceptable CFI and RMSEA values were achieved at the scalar model (Δ RMSEA = .04, Δ CFI=−.01), which allowed us to proceed with statistical analysis to compare the groups. Regarding age range, scalar invariance was not achieved. Despite an acceptable model fit (RMSEA=.042, CFI = .940) and a small difference in RMSEA (Δ RMSEA = .005), Δ CFI (−.018) was above the cut-off value. We proceeded with single-item invariance analysis and noticed that items 12, 13, 14, and 15 accounted for the higher differences between models. Releasing constraints on these items, a slight change in model fit was observed (Δ CFI=−.008; Δ RMSEA = .002). This could allow partial measurement invariance to be achieved (Byrne et al., 1989). However, these unconstrained items represent almost the totality of the subscale intentions, putting aside the required theoretical meaningfulness to proceed with group comparisons.

Convergent validity

We found a significant positive association, although small, between CCAS and the PYD-SF scale total scores for each group, except for the 22–24 cohort (see Table 4). A high positive and significant association was

Table 4. Pearson correlations between CCAS and PYD-SF scales.

Demographic groups		CCAS	PYD-SF Total Score	PYD-SF Competence	PYD-SF Confidence	PYD-SF Character	PYD-SF Caring	PYD-SF Connection
Assigned sex	Female	Total score	.210**	-.050	-.005	.431**	-.662**	.842**
		Beliefs	.249**	.027	.033	.468**	-.384**	.956**
		Intentions	.103	-.148***	-.058	.275**	-.907***	.477***
	Male	Total score	.314**	.136	.140	.468**	-.453**	.767***
		Beliefs	.447**	.267**	.225**	.567***	-.014	.957***
		Intentions	-.017	-.116	-.046	.107	-.907**	.158*
Age range	16–18	Total score	.212**	-.051	-.004	.431**	-.501***	.758***
		Beliefs	.371**	.126	.128	.551**	-.089	.963***
		Intentions	-.106	-.293**	-.199**	.087	-.915**	.217***
	19–21	Total score	.310**	-.012	.022	.531***	-.717***	.851***
		Beliefs	.280**	.018	-.008	.503***	-.506**	.941***
		Intentions	.293**	-.053	.061	.469***	-.881***	.559***
	22–24	Total score	.086	-.033	-.107	.423***	-.603***	.823***
		Beliefs	.053	-.039	-.130	.394***	-.348***	.923***
		Intentions	.116	-.016	-.052	.374***	-.841***	.504***
Total sample		Total score	.242**	-0.39	.012	.483***	.355*	.053
		Beliefs	.322**	.067	.072	.531***	.378***	.089*
		Intentions	.088*	-.141**	-.046	.277***	.224***	.008

Note. *p < 0.05 **p < 0.01.

Table 5. Differences among female and male samples concerning beliefs and intentions.

	Female (n = 342) Mean (SD)	Male (n = 157) Mean (SD)	U
Beliefs	4.47(0.551)	4.22(0.694)	20637.000***
Intentions	4.19(0.761)	3,75(0.941)	19136.000***

Note. SD=Standard Deviation; U= Mann-Whitney test statistic; ***p < 0.001.

found in most subgroups between CCAS total score, beliefs, and intentions subscales and PYD-SF character and connection subscales. A significant but negative association was found for all subgroups between CCAS total score and intentions and the PYD-SF caring subscale.

Assigned sex differences

Comparisons among subgroups (female and male) through the Mann-Whitney test (see Table 5) have shown significant differences between male and female samples regarding beliefs (U = 20637.000, p < .001) and intentions (U = 19136.000, p < .001). The female sample has shown stronger beliefs and intentions.

Discussion

We aimed to analyse the psychometric properties of the CCAS (Christensen & Knezek, 2015) among Portuguese adolescents and emerging adults and explore its relationship with PYD. The results from EFA revealed that an enhanced 18-item version is not suitable for this sample. Regarding the 15-item version, CFA results confirmed the original factor structure. Scalar invariance regarding assigned sex was achieved, and significant differences were identified, despite the uneven sample sizes. As asserted in previous research, females had stronger beliefs and intentions than males (e.g., Pearson et al., 2017). Regarding age range, we noticed that most items of the intention subscale accounted for non-invariance and are related to the perceived role of respondents' action within climate change. Within these age ranges, different levels of autonomy (from adults) are expected (Sanson et al., 2018), which may influence the perceived capacity to act. Finally, we verified that a global positive attitude towards climate change in youth has a small positive and significant association with PYD. These results

align with a Norwegian study (Bøhlerengen & Wiium, 2022) whose findings suggest that youth's experience of the 5Cs had a significant influence on their attitudes towards the environment, among other variables. In addition, research acknowledges a feedback loop between environmental dimensions and PYD. Nature constitutes a developmental resource (Bowers et al., 2021), and concern for the environment is an indicator of PYD (Gomez-Baya et al., 2020). We found a strong and significant association between the total score and beliefs subscale of the CCAS and the PYD-SF character subscale. Another study has also found that character was mostly associated with environmental attitudes and behaviours (Bøhlerengen & Wiium, 2022). Bowers et al. (2021) suggest that character promotion could lead to stronger pro-environmental values and morality. In contrast, an unexpected negative but significant association was found between the CCAS total score and the intentions subscale and the caring PYD-SF subscale. We argue that caring may have multiple contextually dependent meanings and carries the potential risk of internalizing problems if the individual cares excessively (Geldhof et al., 2019). Relatedly, McKenzie (2006) suggests the concept of 'inactive caring,' when students care but feel unable to make positive change, which may be applied to the climate change context.

Our results bring insights regarding the relevance of promoting attitudes within this age range, framed by a PYD approach. However, we acknowledge some limitations. Sample characteristics, with an unbalanced number of males and females do not allow for the generalization of the results obtained. Future studies should account for balanced samples. Additional research is also required to clarify the statistical robustness and theoretical meaning of a possible third factor, as was hypothesized by the authors of the original scale (Christensen & Knezek, 2015).

We conclude that the 15-item version of the CCAS represents a valid and reliable instrument for assessing Portuguese adolescents and emerging adults' beliefs and intentions towards climate change. This study adds evidence to the emerging developmental researchers' interest in climate change. Understanding how youth are positioned regarding climate change issues can inform developmental approaches focused on building their capacities to participate in decision-making. In turn, providing positive youth development opportunities may lead

to civic action and to increased personal responsibility for the environment.

Disclosure statement

Funding

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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