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ORIGINAL ARTICLE

Validity, Reliability, and Cross-Cultural Comparability of a Problematic Overstudying Scale across European, North American, and Asian countries

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Abstract
Problematic overstudying has been conceptualized as a potential addictive disorder and an early form of work addiction. Previous studies have shown that it is a different phenomenon from healthy learning engagement and is associated with considerable functional impairments. A valid, reliable, and convenient screening measure is warranted to provide cross-culturally comparable and generalizable findings, particularly from large epidemiological studies. The seven-item Bergen Study Addiction Scale (BStAS), based on an addiction framework, was administered alongside learning engagement and anxiety measures in a total sample of 5,884 university students from three continents and five countries: India, Norway, Poland, Portugal, and the United States. The modified five-item version of the scale showed measurement invariance across countries and between genders and allowed for meaningful cross-cultural and gender comparisons. Scores on the BStAS were positively associated with learning engagement, anxiety, and female gender across countries. Clinically significant anxiety levels occurred about 1.7 times more often among students who scored above the cutoff for study addiction. It is concluded that the five-item BStAS is a valid, reliable scale that can be used in different cultures and provides comparable and generalizable results. Future studies with the BStAS may provide greater insight into the nature of problematic overstudying.

Keywords Bergen Study Addiction Scale · Cross-cultural · Overstudying · Study addiction · Workaholism · Work addiction

Highlights
- Problematic overstudying is defined as an addictive and harmful behavior
- The Bergen Study Addiction Scale (BStAS) showed good validity and reliability
- Scores on the five-item BStAS are cross-culturally comparable and generalizable
- Problematic overstudying was associated with higher anxiety across countries
- Females tended to show higher problematic overstudying across countries

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Problematic overstudying has been conceptualized as a potential addictive disorder and an early form of work addiction (Atroszko, 2015, 2022a, b). It is congruent with the notion that student learning and associated coursework can be considered work (Griffiths et al., 2018; Sussman, 2018). Problematic overstudying has also been referred to as "study addiction" (Atroszko et al., 2015), "compulsive study behavior" (Woropay-Hordziejewicz et al., 2022), and "studyholism" (Loscalzo & Giannini, 2018a). Such behavior is a plausible candidate to be recognized as a formal diagnostic entity, provided that more high-quality research is conducted (cf. Griffiths, 2022). Some scholars conceptualize it as an obsessive–compulsive disorder (Loscalzo & Giannini, 2018a). However, its (i) phenomenological manifestation (appetitive effects, distinctive craving, loss of control, and withdrawal symptoms), (ii) lack of characteristics typical for obsessive–compulsive disorders and behaviors (e.g., simple repetitive motor behaviors such as hand washing, negatively reinforcing/to remove anxiety), and (iii) similarities and longitudinal relationship with work addiction (Atroszko et al., 2016a, b; Atroszko, 2015, 2022a, b; Griffiths et al., 2018; Sussman, 2012) suggest that problematic overstudying can be viewed as an addictive disorder/problem.

A recent study supported this by showing that almost 30% of students manifesting all study addiction symptoms had low and very low scores on obsessive–compulsive personality disorder (OCPD) symptomatology, and problematic overstudying was more strongly associated with decreased well-being than OCPD characteristics were (Atroszko et al., 2023). Multistep systematic studies on the phenomenology of problematic overstudying showed that typical addiction symptoms of craving, loss of control, withdrawal, tolerance, and obsession (initially operationalized with six to seven items per each symptom pre-screened and chosen by five competent judges from a larger pool of items) showed very high inter-correlations and confirmatory factor analytic results indicated their convergence, suggesting that they represent the general compulsion component of study addiction (Atroszko, 2015). Together with excessive studying/study overload, health problems, and neglecting social relationships, this compulsion component represented a crucial addiction symptom (for a detailed analysis, see Atroszko, 2022b). Moreover, it is distinct from obsessive–compulsive disorders because it concerns planned behavior involving higher-order cognitive processes and attempts to achieve some appetitive effect and satiation through engagement in it (cf. Sussman & Sussman, 2011).

Similar to work addiction, OCPD may still be a strong risk factor in a number of cases. This relationship is analogous to well-established associations of personality disorders (including OCPD) with other addictive disorders (DeJong et al., 1993). It may reflect an interaction between specific personality-related risk factors and the coping function of the behavior. Study addiction has also been associated with social anxiety, eating disorders, anxiety, and depression (Atroszko, 2015; Lawendowski et al., 2020; Woropay-Hordziejewicz et al., 2022), which constitute comorbidities affecting the severity of functional impairments. However, more systematic studies are required to establish the nature of the associations between problematic overstudying and other mental health problems. Therefore, a valid, reliable, and convenient measure of study addiction is warranted to provide cross-culturally comparable and generalizable findings, particularly from large epidemiological studies.

The present study investigated the validity, reliability, and measurement invariance of the most widely used study addiction scale (i.e., the Bergen Study Addiction Scale [BStAS]; Atroszko et al., 2015) across (i) countries from three continents and various cultural and socioeconomic backgrounds (i.e., India, Norway, Poland, Portugal, and the United States [US]), and (ii) gender. Moreover, concurrent validity was assessed by analyzing the relationships of the BStAS with anxiety, learning engagement, and gender. While

employed in various countries, a cross-country comparison of the measure's utility has not been carried out.

The BStAS was developed to assess seven components of addiction (i.e., salience, tolerance, mood modification, relapse, withdrawal, conflict, and problems; see Griffiths, 2005) in relation to study behaviors conceptualized as an early form of work addiction (Atroszko et al., 2015). It has been used in studies in various countries, including Germany, India, Italy, Norway, Poland and Turkey (Andreassen et al., 2013; Bisht & Godiyal, 2016; Czerwiński et al., 2022; Godzwon et al., 2022; Kircaburun et al., 2021; Kozak et al., 2020; Lawendowski et al., 2020; Loscalzo & Giannini, 2018b; Schaefer & Strob, 2023; Wróbel, 2020). It was found to be convergent with another measure of study addiction – the Multidimensional Inventory: Learning Profile of a Student (MILPoS) – in Norwegian and Polish samples (Atroszko, 2022b). In particular, while the BStAS is a brief screening tool, the MILPoS was designed to assess comprehensively study addiction symptoms, profiles, and potential risk factors (Atroszko, 2015). So far, the BStAS has shown good factorial and criterion validity, supporting its construct validity, in numerous studies on different populations of undergraduate students (Atroszko, 2015; Atroszko et al., 2015; Kircaburun et al., 2021; Lawendowski et al., 2020; Schaefer & Strob, 2023) and high school students (Wróbel, 2020).

Most importantly, the data consistently support associations of the BStAS with indicators of considerable harm, including mental health problems such as anxiety and depression, lower quality of life, general health and sleep, chronic stress, test anxiety, and higher cardiovascular reactivity to stress, which is associated with increased risk of cardiovascular disease (see Atroszko [2022a, b] for a review). Scores on the BStAS are highly stable over one year (Atroszko et al., 2016b) and are longitudinally related to scores on an analogous work addiction scale (Bergen Work Addiction Scale [BWAS]; Andreassen et al., 2012) after students completed their academic studies and started in a paid job (Atroszko et al., 2016a).

BStAS scores correlate positively with learning engagement (Atroszko, 2015; Atroszko et al., 2015; Czerwiński et al., 2022; Lawendowski et al., 2020; Wróbel, 2020), and its components (Atroszko & Atroszko, 2019) due to shared factors of high time and effort involvement, which are characteristic of both phenomena. However, studies show that while learning engagement positively correlates with well-being and academic/school performance, study addiction is consistently related to deteriorated psychosocial functioning. Moreover, since learning engagement is one of the most commonly investigated constructs in educational research, study addiction should be accounted for in any analyses of this variable. It was previously reliably shown that associations of learning engagement with other variables are confounded by study addiction and vice versa (Atroszko, 2015; Atroszko & Atroszko, 2019; Atroszko et al., 2015, 2019a, b; Czerwiński et al., 2022; Wróbel, 2020). These studies have demonstrated that study addiction attenuates associations of learning engagement with positive outcomes, and learning engagement reduces the strength of relationships of study addiction with potential negative outcomes. Consequently, any study investigating these phenomena runs the risk of being biased if one does not account for their shared components.

Previous research has suggested that the problem of measurement error and the precision of measurement is common to all psychological variables, and the confounding effects of high engagement or frequency of behaviors and addiction are common to the assessment of all addictive behaviors (Maraz et al., 2015), including screening for substance use disorders (Higgins-Biddle & Babor, 2018). The psychometric challenge is to minimize the error and maximize the diagnostic utility of the problematic overstudying instruments and the validity of learning engagement scales.

Study addiction is relatively prevalent among undergraduate and high school students, with estimates based on the cut-off score for the BStAS showing rates between 6.4% to 17.0% depending on the country and sample characteristics (detailed analysis can be found in Atroszko, 2022a). These are mostly comparable to estimates based on a nationally representative sample of Poland's general population, which found symptoms associated with addictive work-related behaviors among 8.1% of undergraduate and high school students (Moskalewicz et al., 2019). A study showed that study addiction is more prevalent than other addictive behaviors (such as food intake, shopping, pornography, gaming, and Facebook use; Charzyńska et al., 2021). It is congruent with overall estimates of the prevalence of these behaviors in previous research (detailed analysis can be found in Atroszko et al. [2021]).

Study addiction is typically more frequent among female students (Atroszko, 2015; Atroszko et al., 2015; Charzyńska et al., 2021; Kircaburun et al., 2021). However, this (to some extent) depends on the sample size and characteristics. Smaller and/or non-significant effect sizes have been reported in music academy students, which may be explained by generally higher learning engagement and perfectionism of both females and males within this population (Czerwiński et al., 2022; Lawendowski et al., 2020). On the other hand, a study on a more general population of more than 1,500 high school students in Poland showed that the difference between genders was more than three-fold (6.2% in males, 21.2% in females; as measured by the full seven-item BStAS and adopting a polythetic cut-off score; Wróbel, 2020). While gender differences in study addiction and other behavioral addictions are pronounced, they are still poorly understood (Charzyńska et al., 2021), especially in comparison to substance use disorders (McHugh et al., 2018).

Valid and reliable problematic overstudying measures may facilitate research directed at understanding different risk factors and outcomes of study addiction for females and males, including the potential moderating role of macro-level factors related to socioeconomic and cultural variables. For example, previous studies have demonstrated that narcissism and other dark personality traits are related to study addiction among males and not females (Kircaburun et al., 2021), and it may be moderated by macro-level factors related to culture, socioeconomics and/or educational systems (Atroszko et al., 2019b).

The studies conducted to date are reasonably consistent and warrant further systematic investigation of problematic overstudying worldwide. While the current study does not aim to provide conclusive data on the nature of problematic overstudying, it may enable future global systematic research to address this problem. Based on the theoretical framework of study addiction and previous empirical studies, it was hypothesized that (i) the BStAS would show measurement invariance across countries and genders (H_1); (ii) study addiction would be positively related to anxiety and learning engagement across countries and genders (H_2); and study addiction would be positively associated with female gender (H_3).

Methods

Participants

The samples were recruited in studies examining study addiction in different countries: India, Norway, Poland, Portugal, and the US. Data from all samples were collected using convenience sampling, and all except the Portuguese sample were online samples. In all samples, students were from different faculties, degree courses, modes of study, and years

of study within their country. The data from the Norwegian and Polish samples were collected for the first wave of a longitudinal study. All other studies were part of cross-sectional assessment studies. Across countries, the overall sample size was 5,884. The date of data gathering, the number of participants, and their gender distribution and mean age can be found in Table 1. A detailed description of sampling procedures and samples can be found in the Supplementary Material.

Measures

The same measure of study addiction and learning engagement was administered in all samples. Anxiety was assessed with two different measures depending on the sample, and was not assessed in the US because that study focused on personality and academic functioning variables. Table 1 shows sample sizes, percentages, mean scores and standard deviations (SD), and Cronbach's alpha reliability coefficients of study variables in each sample.

Study addiction Study addiction was assessed with the BStAS (Atroszko, 2015; Atroszko, et al., 2015), which includes seven items based on the core components of the addiction concept (Griffiths, 2005). It was developed in analogy to the BWAS (Andreassen et al., 2012). The items concern the symptoms experienced during the past 12 months. Each item (e.g., "*How often during the last year have you studied so much that it has negatively influenced your health?*") is rated on a five-point Likert scale with responses ranging from 1 (*never*) to 5 (*always*). The scale has shown good validity and reliability in previous studies among undergraduate and high school students (Atroszko, 2015; Atroszko et al., 2015, 2016a, b; Czerwiński et al., 2022; Kircaburun et al., 2021; Wróbel, 2020). However, in a few samples from different countries, some items showed non-optimal psychometric performance (Lawendowski et al., 2020; Loscalzo & Giannini, 2018b; Schaefer & Strob, 2023; Woropay-Hordziejewicz et al., 2022).

Learning engagement Learning engagement was assessed using a single-item measure: "*How engaged in learning are you*?" (Atroszko, 2014). The question was rated on a seven-point Likert scale with responses ranging from 1 (*I am not at all engaged*) to 7 (*I am completely engaged*). The measure has shown good validity (Łukowicz et al., 2017) and test–retest reliability (intraclass correlation coefficient [ICC] was 0.77) in previous studies (Atroszko, 2014). Due to its single-item nature, it has been thoroughly investigated in terms of the domains it covers, showing good construct validity (Atroszko et al., 2019a). It has also shown good divergent validity with the BStAS in a number of studies (Atroszko, 2015; Atroszko et al., 2015; Czerwiński et al., 2022; Lawendowski et al., 2020; Wróbel, 2020).

Anxiety (1) Anxiety was assessed using the Short Anxiety Scale (SAS; Clarke et al., 2008), which comprises five items (e.g., "*I had fear of the worst happening*"). The questions concern symptoms experienced in the past week. Each item is rated on a four-point scale ranging from 1 (*never*) to 4 (*most of the time*). The scale has shown good validity and reliability in a previous study (Charzyńska et al., 2021). Due to its brevity, it was used in large longitudinal surveys in Norway and Poland.

Anxiety (2) The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) scale consists of seven items that assess the level of anxiety (e.g., "*I feel tense or* '*wound up*'"). Each item is rated on a four-point scale with response categories from 0

Table 1 Sample sizes, percentages, mean scores (M) and standard deviations (SD), and Cronbach's alpha reliability coefficients of study variables

			Date of study	Age	Study addiction			Learning engagement	Anxiety	
		N (%)	Month and year	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	Cronbach's alpha	*M* (*SD*)	*M* (*SD*)	Cronbach's alpha
India		577	September 2020	20.55 (2.77)	17.92 (4.44) [a]	11.61 (3.61) [b]	.64[a] /.58[b]	5.14 (1.29)	9.49 (3.66)[c]	.70[c]
	Females	442 (76.6%)		20.21 (2.52)	17.99 (4.52) [a]	11.63 (3.69)[b]		5.18 (1.25)	9.48 (3.70)[c]	
	Males	135 (23.4%)		21.66 (3.22)	17.68 (4.16) [a]	11.55 (3.38)[b]		5.00 (1.41)	9.52 (3.54)[c]	
Norway		2,548	September to December 2013	24.65 (7.37)	16.30 (4.91) [a]	10.88 (3.90)[b]	.80[a] /.79[b]	5.30 (1.11)	7.06 (2.55)[d]	.76[d]
	Females	1,739 (68.2%)		24.53 (6.08)	16.97 (4.92) [a]	11.42 (3.95)[b]		5.41 (1.05)	7.36 (2.61)[d]	
	Males	809 (31.8%)		24.96 (5.86)	14.86 (4.57) [a]	9.71 (3.51)[b]		5.07 (1.18)	6.41 (2.30)[d]	
Poland		2,174		21.97 (3.12)	17.18 (5.11)[a]	11.09 (4.09)[b]	.79[a] /.77[b]	5.01 (1.17)	8.15 (2.68)[d]	.75[d]
	Females	1,615 (74.3%)		21.98 (3.18)	17.63 (5.09)[a]	11.39 (4.11)[b]		5.12 (1.09)	8.33 (2.70)[d]	
	Males	559 (25.7%)		21.95 (2.94)	15.90 (4.97)[a]	10.23 (3.92)[b]		4.67 (1.31)	7.64 (2.56)[d]	
Portugal		309[e]	January 2019	21.17 (3.75)	19.16 (4.90)[a]	12.53 (4.13)[b]	.68[a] /.69[b]	5.42 (1.08)	9.18 (4.21)[c]	.81[c]
	Females	211 (69.6%)		20.88 (2.895)	19.42 (5.03)[a]	12.80 (4.22)[b]		5.43 (1.06)	9.78 (4.21)[c]	
	Males	92 (30.4%)		22.01 (4.82)	18.56 (4.75)[a]	11.90 (4.01)[b]		5.39 (1.15)	7.75 (4.03)[c]	
US		276[e]	February to May 2018	20.96 (4.79)	19.19 (5.66)[a]	13.05 (4.40)[b]	.83[a] /.80[b]	5.35 (1.06)	—	—
	Females	184 (68.7%)		21.02 (5.23)	19.55 (5.66)[a]	13.28 (4.37)[b]		5.51 (0.89)	—	—
	Males	84 (31.3%)		20.45 (3.06)	18.51 (5.52)[a]	12.61 (4.42)[b]		5.01 (1.30)	—	—
Females		4,191 (71.4%)		22.78 (4.85)	17.57 (5.03)[a]	11.58 (4.04)[b]	.77[a] /.75[b]	5.28 (1.09)	9.57 (3.87)[c] / 7.82 (2.69)[d]	.73[c] / .75[d]
Males		1,679 (28.6%)		23.20 (5.07)	15.82 (4.89)[a]	10.30 (3.81)[b]	.77[a] /.74[b]	4.94 (1.26)	8.80 (3.84)[c] / 6.91 (2.48)[d]	.72[c] / .75[d]

[a] Seven-item version of the BStAS; [b] Five-item version of the BStAS;[c] HADS; [d] SAS; [e] The total number of participants also includes students who did not provide an answer to the question on gender. Anxiety was not assessed in the US sample

to 3, whose labels vary depending on the items. It has shown good validity and reliability in previous research, including screening studies among student samples (Czerwiński et al., 2020). It was used in cross-sectional surveys in India and Portugal because it has well established diagnostic cut-off score (Bjelland et al., 2002).

Procedure

A detailed description of procedures concerning online platforms used to gather data, invitation procedures, response rates, and rewards for participation applied in particular samples can be found in Supplementary Materials. In all countries, the study was anonymous.

Statistical Analysis

The analysis started with the imputation of missing data using the expectation–maximization (EM) algorithm implemented in Missing Values Analysis within IBM SPSS version 27. This method was deemed sufficient given that the percentage of missing data was small (less than 1%).

Confirmatory Factor Analysis (CFA) The factor structure of the BStAS was analyzed using CFA with the maximum likelihood estimation with robust standard errors (MLR). A single-factor model representing one latent construct of study addiction was assumed. The following model indices were calculated: Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Squared Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). The model fits the data well when: CFI and TLI ≥ 0.95, RMSEA < 0.06, and SRMR < 0.08 (Schreiber et al., 2006). An acceptable model fit is indicated by CFI and TLI ≥ 0.90, RMSEA < 0.08, and SRMR < 0.1 (Wang & Wang, 2012).

Measurement Invariance A series of CFAs were conducted to test the measurement invariance of the BStAS between genders and across five countries involved in the study (India, Norway, Poland, Portugal, and the US). First, the models were freely estimated for each group. Second, three nested models with increasingly constrained parameters were estimated using a multiple-group CFA (MGCFA), separately for genders and countries: (i) factor loadings and intercept parameters were freely estimated in each group (configural invariance), (ii) factor loadings were set to be equal between/among groups and intercept parameters were freely estimated in each group (metric invariance), and (iii) factor loadings and intercept parameters were set to be equal between/among groups (scalar invariance).

The following differences in fit indices were treated as indicators of measurement invariance of a more constrained model: ΔCFI and ΔTLI ≥ 0.010 and ΔRMSEA ≤ 0.015, ΔSRMR ≤ 0.030 (for loading invariance) and ΔSRMR ≤ 0.010 (for intercept invariance) (Chen, 2007; Cheung & Rensvold, 2002). If the criteria for measurement invariance were not met for all items, modification indices were inspected to identify the non-invariant items, and the models were then refined to check if they were in line with the requirements of partial invariance (i.e., at least two invariant indicators per latent variable; Byrne et al., 1989). After establishing scalar invariance, latent means were compared between genders and across the countries. All calculations were performed using Mplus Version 8 (Muthén & Muthén, 2017).

Descriptive Statistics Means, standard deviations, percentages, and reliability coefficients were calculated with IBM SPSS 27.0. The prevalence of study addiction was calculated in accordance with the cut-off based on a polythetic approach (i.e., scoring 4 [*often*] or 5 [*always*] on at least four of the seven items; Andreassen et al., 2012). The polythetic approach utilized in the present study is in line with modern psychiatric (DSM–5) nosology. Also, a monothetic approach was used with the cut-off based on scoring 4 [*often*] or 5 [*always*] on all items.

Correlational Analysis To examine the relationships between the study variables, point-biserial correlation coefficients, and Pearson product-moment correlation coefficients with 95% confidence intervals (CIs) were calculated in accordance with the measurement scale employed. Partial correlations were calculated to estimate the association between learning engagement and anxiety when adjusting for study addiction.

Ethics

Since major health outcomes were not assessed in the present study, the Regional Committee for Medical and Health Research Ethics in Norway deemed the project to fall outside their jurisdiction. Ethical principles were carried out in accordance with the Declaration of Helsinki. The project was approved by both the Norwegian Data Protection Official for Research and the Research Ethics Committee at the Psychology Department of the University of Gdańsk in Poland. In the present study, informed consent was achieved through full voluntary participation in the survey.

Results

Confirmatory Factor Analyses

The results of the CFAs in all countries and genders are presented in Table S1, with standardized factor loadings in Table S2. After analyses, two items of the scale (Item 1, "*Thought of how you could free up more time to study?*" and Item 2, "*Spent much more time studying than initially intended?*") were removed due to their low factor loadings in some countries and below the acceptable threshold of > 0.40 in Portugal. Moreover, these items showed non-optimal psychometric performance in some of the previous studies (Lawendowski et al., 2020; Loscalzo & Giannini, 2018b; Schaefer & Strob, 2023; Woropay-Hordziejewicz et al., 2022). After removing these two items, the model fit for the five-item version of the BStAS for each country and both genders was either good or acceptable (see Table S1).

Measurement Invariance

The results of the measurement invariance analysis for genders and countries are presented in Table 2. In the configural model, the fit indices were within the range of acceptability for both genders and countries. The metric model showed negligible differences in fit indices compared to the configural model both for genders and countries. The scalar invariance of the BStAS between genders was supported by the small changes in fit indices compared to

Table 2 Model fit indices and model comparison of the measurement invariance for the five-item BStAS

	Model	χ^2	*df*	CFI	TLI	RMSEA (90% CI)	SRMR	Model comparison	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR
Country												
	(A) Configural	181.86	25	.970	.940	.073 (.063, .083)	.027					
	(B) Metric	228.09	41	.964	.956	.062 (.055, .070)	.038	B vs A	−.006	.016	−.011	.011
	(C) Scalar	868.98	57	.844	.863	.110 (.104, .117)	.086	C vs B	−.120	−.093	.047	.048
	(D) Partial scalar*	252.97	45	.960	.956	.063 (.055, .070)	.041	D vs B	−.004	0	.001	.003
Gender												
	(A) Configural	123.16	10	.974	.949	.062 (.052, .072)	.023					
	(B) Metric	130.54	14	.974	.962	.053 (.045, .062)	.025	B vs A	0	.013	−.009	.002
	(C) Scalar	178.19	18	.964	.960	.055 (.048, .063)	.030	C vs B	−.010	−.002	.002	.005

df degrees of freedom, *CFI* Comparative Fit Index, *TLI* Tucker-Lewis Index, *RMSEA* Root Mean Squared Error of Approximation, *SRMR* Standardised Root Mean Residual, Δ change between a less restricted and a more restricted model

*Free intercept of Items 3, 5, and 6 (items numeration before removing the two first items from the BStAS)

the metric invariance model. By contrast, the model fit indices substantially exceeded the recommended scalar invariance threshold across countries. For this reason, after inspection of modification indices, the intercepts of the original Items 3, 5, and 6 of the BStAS were relaxed to let them differ across the countries. Freeing the intercepts improved the model fit substantially, supporting the partial invariance of the five-item BStAS across the five countries (Byrne et al., 1989).

Latent Means Comparisons

Further analysis compared the latent mean differences between the groups based on the establishment of the full scalar invariance between genders and the partial scalar invariance across countries. For gender comparisons, females were chosen as a reference group; therefore, the females' latent mean was constrained to zero. Poland was treated as a reference group for countries since most research on study addiction has been conducted there (for an overview, see Atroszko, 2022a).

The unstandardized latent means for genders and countries are presented in Table S3. To assess the effect size with a 95% CI for gender and cross-country differences, two structural equation models were built: the first model used gender as the independent variable, whereas the second used countries as the independent variable. In both models, study addiction was used as the dependent variable. The differences in latent means between genders and countries expressed as standardized regression coefficients (β) with 95% CIs are shown in Table S4 and Fig. 1.

Females had a higher level of study addiction than males. Regarding differences between samples, students from the US and Portugal scored higher on study addiction than

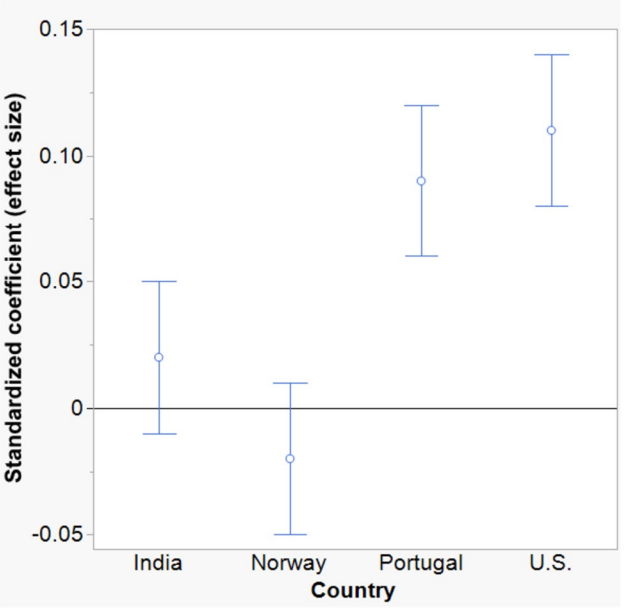

Fig. 1 Standardized regression coefficients in cross-country differences (with Poland as a reference group) in study addiction

students from Norway, Poland, and India (see Table S4 and Fig. 1). Additionally, the differences in study addiction were estimated between genders in each country (see Table S5), and the differences in study addiction were calculated across countries, separately for females and males (Table S6 and Figs. S1 and S2). Results are presented in the Supplementary Material.

Descriptive Statistics and Correlation Analysis

Since previous studies used the seven-item BStAS the present study provides, for comparison purposes, results for both the original seven-item and modified five-item scale. Study addiction correlated positively with learning engagement across countries (among US males, the correlation did not reach statistical significance), and somewhat more strongly for the seven-item in comparison to the five-item version of the BStAS (Table 3). Study addiction correlated positively with anxiety across countries and somewhat more weakly for the seven-item in comparison to the five-item version of the BStAS (Table 3). Correlations were mostly similar between females and males. However, in some countries, a few differences appeared (but did not reach statistical significance). Learning engagement showed considerably higher negative correlations with anxiety when study addiction was controlled for in the analyses (Table 4). The differences reached statistical significance in the largest samples of Norway and Poland. Item 2 and (to a lesser degree) Item 1 typically showed higher correlations with learning engagement and somewhat lower correlations with anxiety than most other items across countries (Table S7).

Prevalence and Co-Occurrence Analysis

Table 5 shows the prevalence (number and percentage) of participants fulfilling a cut-off on the BStAS across countries, including separately for females and males. Congruent with latent means differences, females showed a considerably higher prevalence of study addiction than males across countries. Compared to the full seven-item scale, the modified five-item scale showed about 2 to 3 times lower prevalence on the polythetic cut-off score among females and up to 4 to 5 times lower prevalence among males. The prevalence rates based on the monothetic cut-off score were considerably higher in the US sample than in all other samples.

Among participants meeting the criteria for study addiction (five-item version, polythetic approach) in India, 12 individuals (85.7%) had at least mild anxiety (scores $>=8$ on HADS), and nine individuals (64.3%) had clinically significant levels of anxiety (scores $>=11$ on HADS). Among participants not meeting the criteria for study addiction, 394 individuals (70%) had at least mild anxiety, and 202 individuals (35.9%) had clinically significant anxiety levels. In the group of participants meeting the criteria for study addiction in Portugal, 12 individuals (75.0%) had at least mild anxiety, and nine individuals (56.3%) had clinically significant levels of anxiety. Among participants not meeting the criteria for study addiction in Portugal, 180 individuals (61.4%) had at least mild anxiety (scores $>=8$), and 101 individuals (34.5%) had clinically significant levels of anxiety. In both samples, those meeting the cut-off score for study addiction had approximately 1.7 higher rates of clinically significant levels of anxiety in comparison to those who did not meet the cut-off criterion.

Table 3 Correlation coefficients of study addiction with learning engagement and anxiety (values in parentheses are 95% confidence intervals)

		Version	Learning engagement	Anxiety
India			.31** (.23, .38)	.20** (.12, .27)[a]
	Females			
		7-item	.28** (.19, .36)	.19** (.10, .28)[a]
		5-item	.21** (.12, .30)	.22** (.13, .30)[a]
	Males			
		7-item	.39** (.24, .52)	.24** (.07, .39)[a]
		5-item	.29** (.12, .44)	.32** (.16, .46)[a]
Norway			.19** (.15, .22)	.41** (.38, .44)[b]
	Females			
		7-item	.15** (.11, .20)	.38** (.34, .42)[b]
		5-item	.13** (.08, .17)	.41** (.37, .45)[b]
	Males			
		7-item	.19** (.12, .25)	.42** (.36, .48)[b]
		5-item	.15** (.08, .22)	.47** (.41, .52)[b]
Poland			.33** (.29, .36)	.39** (.35, .42)[b]
	Females			
		7-item	.30** (.26, .35)	.36** (.32, .40)[b]
		5-item	.27** (.22, .31)	.38** (.34, .42)[b]
	Males			
		7-item	.33** (.25, .40)	.42** (.35, .49)[b]
		5-item	.26** (.18, .33)	.43** (.36, .49)[b]
Portugal			.26** (.15, .36)	.37** (.27, .46)[a]
	Females			
		7-item	.26** (.13, .38)	.41** (.29, .51)[a]
		5-item	.22** (.08, .34)	.40** (.28, .51)[a]
	Males			
		7-item	.25* (.05, .43)	.26* (.05, .44)[a]
		5-item	.10 (–.10, .30)	.30** (.10, .48)[a]
US			.28** (.17, .38)	—
	Females			
		7-item	.35** (.22, .47)	—
		5-item	.31** (.17, .43)	—
	Males			
		7-item	.15 (–.07, .35)	—
		5-item	.07 (–.15, .28)	—
Females				
		7-item	23** (.20, .26)	.27** (.20, .34)[a] / .38** (.35, .41) [b]
		5-item	21** (.18, .24)	.29** (.17, .41)[a] / .39** (.36, .42) [b]
Males				
		7-item	.25** (.20, .29)	.22** (.09, .34)[a] / .43** (.39, .47) [b]
		5-item	.19** (.14, .24)	.29** (.17, .41)[a] / .45** (.41, .49) [b]

[a] HADS; [b] SAS. Anxiety was not assessed in the US sample. *$p < .05$, ** $p < .01$

Table 4 Partial correlations of learning engagement with anxiety controlled by study addiction (five-item BStAS; values in parentheses are 95% confidence intervals)

	Study addiction controlled	Anxiety
India	No	–.06 (–.14, .02)[a]
	Yes	–.12** (–.20, –.04)[a]
Norway	No	–.04 (–.08, .01)[b]
	Yes	–.12** (–.16, –.08)[b]
Poland	No	.01 (–.04, .05)[b]
	Yes	–.12** (–.16, –.08)[b]
Portugal	No	.06 (–.05, .17)[a]
	Yes	–.01 (–.14, .13)[a]

[a] HADS; [b] SAS. Anxiety was not assessed in the US sample.*$p < .05$, **$p < .01$

Table 5 Prevalence (number and percentage) of study addiction in the studied samples across countries

		Polythetic approach		Monothetic approach	
		7-item version	5-item version	7-item version	5-item version
India					
	Females	47 (10.6%)	13 (2.9%)	2 (0.5%)	2 (0.5%)
	Males	8 (5.9%)	1 (0.7%)	0 (0%)	0 (0%)
Norway					
	Females	202 (11.6%)	76 (4.4%)	11 (0.6%)	17 (1%)
	Males	45 (5.6%)	12 (1.5%)	0 (0%)	0 (0%)
Poland					
	Females	254 (15.7%)	81 (5%)	14 (0.9%)	21 (1.3%)
	Males	54 (9.7%)	12 (2.1%)	2 (0.4%)	5 (0.9%)
Portugal					
	Females	44 (20.9%)	13 (6.2%)	3 (1.4%)	3 (1.4%)
	Males	16 (17.4%)	3 (3.3%)	1 (1.1%)	2 (2.2%)
US					
	Females	36 (19.6%)	21 (11.4%)	7 (3.8%)	8 (4.3%)
	Males	14 (16.7%)	8 (9.5%)	3 (3.6%)	5 (6%)

A polythetic approach means scoring 4 (*often*) or 5 (*always*) on at least four of the seven items. A monothetic approach was used with the cut-off based on 4 (*often*) or 5 (*always*) on all items

Discussion

The aim of the present study was to investigate the cross-country validity and reliability of the BStAS, the most widely used scale that assesses study addiction (Atroszko et al., 2015). After initial analyses, two items of the scale (Items 1 and 2) were removed due to their low factor loadings in some countries and below the acceptable threshold of > 0.40 in Portugal. Moreover, these items showed non-optimal psychometric performance in some previous studies (Lawendowski et al., 2020; Loscalzo & Giannini, 2018b; Schaefer & Strob, 2023; Woropay-Hordziejewicz et al., 2022). The two items also showed relatively

high correlations with learning engagement and low correlations with anxiety across countries. Inspection of these items suggests that they may, to a considerable degree, cover non-pathological forms of high learning engagement. Being enthusiastic about studying in a healthy way may also cause students to frequently think of how they could free up more time to study or spend much more time studying than initially intended. The modified five-item scale showed partial scalar invariance across countries and scalar invariance between genders (supporting H_1).

These results indicate that meaningful cross-cultural and gender comparisons may be performed based on the scores of the five-item version of the BStAS on the condition that sampling methods used in particular studies ensure comparability of the samples (e.g., random sampling assuring samples representative for the studied populations). Most importantly, they provide important initial evidence for the potential universal nature of the phenomenon of problematic overstudying across industrialized countries, which is not as evident with some other widely investigated addictive problems, such as social networking use disorder, that likely represent substantially different subclasses of problematic behaviors in different cultures and countries (Atroszko et al., 2022). The five-item BStAS is a brief and convenient screening instrument that can be applied in surveys or other research whereby a general score or preferably latent factor score can be used as an indicator of the overall risk of study addiction. Nevertheless, future studies should refine the assessment of problematic overstudying, particularly by covering all components of addiction assessed with properly operationalized and valid items (including attention to content validity) to enable more in-depth investigations of problematic overstudying as an addictive disorder/problem. For example, such analyses may include the structure of symptoms and their associations with other constructs using a network analytic approach (Bereznowski et al., 2021, 2023).

The BStAS showed expected associations with anxiety across countries and between genders (supporting H_2). Items assessing conflict (Item 6), problems (Item 7), and mood modification (Item 3) showed the highest correlations (in most cases) with anxiety across countries (see Table S7). This supports the notion that study addiction is related to significant harm and functional impairments. Moreover, it underlines the need to saturate items with harm component to capture the pathological nature of the assessed construct. For example, an item representing salience referring to the degree to which the behavior becomes the most important aspect of a person's life may emphasize how studying overshadows entirely other activities, such as family-related, likely leading to adverse outcomes (e.g., "*How often during the last year have you completely ignored your family because you preferred to study?*"). Addiction is defined by compulsion and the negative consequences that it leads to. Therefore, clear compulsion- and harm-related items are necessary to properly differentiate high healthy engagement from problematic over-involvement. Clinically significant anxiety levels were approximately 1.7 times more prevalent among students fulfilling the cut-off for study addiction in Portugal and India (samples in which it could be meaningfully calculated based on the well-established cut-off scores for HADS) than those who did not. It is worth noting that most students had at least mild anxiety levels. It is congruent with data showing growing school and academic pressures in the last decades (Cosma et al., 2022; Klinger et al., 2015), associated declines in well-being among adolescents and young adults (De Looze et al., 2020; Pascoe et al., 2020), and widespread phenomena such as educational burnout (Kaggwa et al., 2021; Walburg, 2014).

Addiction and anxiety are intrinsically associated (Lüthi & Lüscher, 2014), and three aspects of the relationship need to be considered. First, anxiety is a risk factor for addictive behaviors (Teng et al., 2021). Second, withdrawal manifests itself often as anxiety,

and anxiety regulates addictive behaviors (Sinha, 2008). Third, anxiety may be a consequence of addiction (Brady et al., 2013). For these reasons, anxiety must be closely linked to the assessment of addictive disorders. In the case of the BStAS, the mood modification item refers to using studying to cope with anxiety. Also, the anxiety disorder screening tool (HADS) was used as a criterion validity measure. Future studies should investigate to what extent anxiety causes, is a manifestation of (withdrawal), regulates (mood modification), and is a consequence of study addiction.

The strength of the association of BStAS scores with anxiety was lower in India compared to other countries, suggesting that macro-level factors (e.g., the value of obtaining higher education) may affect the extent of harm associated with problematic study behaviors. Moreover, associations with anxiety tended to be somewhat higher among males than females, apart from Portugal, where the opposite pattern was found. Gender differences in potential risk factors of study addiction have been investigated previously, and the patterns differed in various countries (Atroszko et al., 2019a, b; Kircaburun et al., 2021). These may result from cultural differences, socioeconomic factors and/or differences in educational systems. For example, socially prescribed gender roles may be associated with the relationship between dark personality traits and study addiction among males and not females in countries scoring higher on masculinity.

The present study's findings suggest that future research should focus on the source of differential associations of study addiction not only in terms of its determinants or risk factors but also in relation to potential harm in various countries and between genders. In addition, differences in the levels of study addiction between countries, to some extent resembling differences in the prevalence of work addiction in representative samples in the respective countries (i.e., Poland and Norway; Atroszko, 2022a), point to the potential role of macro-level factors (e.g., labour market regulations and associated educational pressures). However, studies using nationally representative samples are necessary to estimate these differences reliably. In the present study, different cut-off scores were used, and the results showed how sensitive prevalence estimates are to these arbitrarily chosen methods of estimating how common this behavioral pattern is. Particularly, items of limited validity and clinical utility may bias results towards overestimation. Until official diagnostic criteria are developed, alternative approaches (e.g., based on latent profile analysis) may provide better estimates of the prevalence of high levels of problematic overstudying (cf. Kun et al., 2023).

BStAS scores were positively associated with learning engagement across countries (confirming H_2). Problematic overstudying may share common components of time and effort with learning engagement. Moreover, the absorption component of engagement, considerably associated with study addiction in previous research (Atroszko & Atroszko, 2019), is likely a gateway to addiction under stressful circumstances. Individuals engrossed in studying may develop study addiction because the absorption component is phenomenologically very similar to the experience of the "high" obtained with drugs, that is, feeling elated, fully focused on studying, forgetting about everything else, and having difficulties detaching from the activity. This way, a positive and gratifying phenomenon may lead to the development of compulsive behavior among individuals at risk because they may use this absorption experience to escape difficult emotions, stress, and other life problems (Jouhki & Oksanen, 2022). This mechanism is supported in work addiction by the network analysis of the structure of work addiction symptoms, work engagement components, stress, and burnout (Bereznowski et al., 2023). For this reason, average levels of engagement and addiction may coexist among some individuals, as evidenced by a recent latent profile analysis study of work addiction and work engagement (Gaudiino & Di Stefano,

2023), either in a transition phase from engagement to addiction or in a more stable manner among those who show some degree of both phenomena.

When BStAS score was controlled for, learning engagement tended to show different strengths of associations with anxiety. It is congruent with previous studies showing that study addiction confounds relationships of learning engagement with other variables and vice versa (Atroszko, 2015; Atroszko & Atroszko, 2019; Atroszko et al., 2015, 2019a, b; Czerwiński et al., 2022; Wróbel, 2020). Learning engagement is one of the most commonly investigated variables in educational research and positively correlates with academic/school performance. However, little research has been carried out examining its associations with well-being. On the other hand, study addiction has consistently been shown to be related to impaired psychosocial functioning. Therefore, all research on learning engagement should control for compulsive study behaviors to avoid biased results and discern whether or not healthy study habits are being tapped.

It needs to be emphasized that measurement error and confounding effects are common in psychology, epidemiology, and other fields that rely on psychometric testing, but they are still rarely addressed (van Smeden et al., 2021). In the present study, it was shown to what extent results may be biased due to shared components of study addiction and learning engagement. The present study also described the procedure to counteract these effects. Controlling in the analysis for one of these variables whenever the other is investigated is one method to address this potential bias, especially when latent variable models, which estimate measurement error, cannot be used in large epidemiological studies or other surveys.

Study addiction tended to be higher among females than males across countries, apart from India (supporting H_3), congruent with most previous findings (Atroszko, 2015; Atroszko et al., 2015; Charzyńska et al., 2021; Kircaburun et al., 2021; Wróbel, 2020). The differences were highest and statistically significant in Poland and Norway. This points to important gender differences in addictive behaviors' risk, which are currently poorly understood (Charzyńska et al., 2021). Theoretical analyses suggest that in the case of study addiction, social pressures on academic performance and differential responses to them among females and males may (to some extent) explain a higher risk for problematic overstudying among females (Atroszko et al., 2021). It is consistent with findings that, in the context of addiction development, (i) females and males respond to stress and cope with it differently (Fox & Sinha, 2009), and females report greater fear and have a higher risk for anxiety disorders than males (McLean & Anderson, 2009), (ii) females are more punishment sensitive, which has particular meaning within educational systems based on constant and continuous formal and informal evaluation of performance (Cross et al., 2011), and (iii) academic achievements are related to social perception, and social appearance motives are also associated with a higher risk of other addictive behaviors more prevalent among females such as problematic social media use disorder (Marino et al., 2018) and compulsive shopping (Maraz et al., 2016). Study addiction has been found to be closely associated with these addictive behaviors (Charzyńska et al., 2021).

The present study has implications for future assessment of study addiction. Most importantly, scales should be designed to minimize the assessment of components characteristic of healthy learning engagement or general high investment of time and effort into study-related behaviors and maximize diagnostic validity and clinical usefulness. It can arguably be achieved by adequately saturating items with functional impairment, significant harm content, and phenomenology characteristic for addictive disorders, including craving, mood modification, and withdrawal symptoms. The five-item BStAS is a brief and

convenient screening measure that can be validly used in large surveys. However, more comprehensive scales covering a wider spectrum of symptoms are needed for more in-depth investigations of problematic overstudying as an addictive disorder/problem.

Strengths and Limitations

To the best of the authors' knowledge, the present study is the first to investigate the measurement invariance of the BStAS across such diverse samples in terms of language and culture. It comprised relatively large sample sizes allowing for sufficiently powered and meaningful statistical analyses. Concurrent validity was measured with valid and reliable tools. The detailed statistical analyses showed the importance of differentiating between study addiction vs. learning engagement. They provide a backdrop for future in-depth analyses of cross-cultural assessment of these constructs.

In terms of limitations, the studies used predominantly female convenience samples that are not nationally representative, which limits the generalizability of the results. In particular, the sampling method may affect the general prevalence estimates and, to less extent, relative estimates depending on gender, version of the scale, and the cut-off approach employed. Therefore, the results in different countries are not directly comparable. Assessment of anxiety was not identical across all samples and was lacking in the US sample. However, measurement invariance across countries and similar correlation patterns of the scale and items with gender and learning engagement suggest that similar associations with harm and functional impairment may be expected in the US (likely somewhat stronger due to a relatively weaker association with learning engagement in comparison to other samples). Moreover, all data collected were self-reported, making it vulnerable to limitations associated with such data (e.g., common method, social desirability, and recall biases).

Conclusions

The present study is the first to analyze the validity and reliability of the BStAS across countries from considerably different cultures and socioeconomic makeup. The modified/reduced scale showed measurement invariance across countries and between genders allowing for meaningful cross-cultural and gender comparisons. Scores on the BStAS were associated (as expected) with higher learning engagement, anxiety, and female gender across countries. Clinically significant anxiety levels were approximately 1.7 times more often among students who fulfilled the cut-off for study addiction. It is concluded that the five-item version of the BStAS is a valid, reliable scale that can be used in different cultures and may provide comparable and generalizable results on condition that sampling methods used in particular studies assure comparability of the samples (e.g., random sampling assuring samples representative for the studied populations). All research on learning engagement should control for compulsive study behaviors and vice versa to avoid biased findings underestimating the relationship of learning engagement with positive outcomes and study addiction with negative outcomes.

Problematic overstudying and learning engagement scales should be refined to minimize overlap between these constructs. Otherwise, statistical models (e.g., latent variable analyses) and procedures (controlling for confounding variable) should be applied to account for their shared variance. Future studies with the BStAS, particularly large epidemiological

surveys, may provide more insight concerning the nature of problematic overstudying, the factors affecting different prevalence rates, determinants, and consequences between females and males, and potential cross-cultural differences indicating the role of macro-level factors.

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Data Availability The data are available from the authors upon reasonable request.

Declarations

Ethics Approval Since major health outcomes were not assessed in the present study the Regional Committee for Medical and Health Research Ethics deemed the project to fall outside their jurisdiction. However, the project was approved by both the Norwegian Data Protection Official for Research and the Research Ethics Committee at the Psychology Department of the University of Gdańsk. In the present study, informed consent was achieved through full voluntary participation in the survey.

Conflict of Interest All authors declare that they have no conflict of interest regarding this manuscript.

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