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The Upside of Teachers' Technostress: Adaptation and Validation of a Techno-eustress Scale

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Digital education transformation introduced a new source of stress for higher education teachers (HETs). Research has studied the effects of technostress, or technology-induced stress, focusing on its harmful consequences (techno-distress). Recent literature further suggests that technostress can also benefit individuals and organizations (techno-eustress), contributing to wellbeing, effectiveness, and performance. However, techno-eustress measurements are scarce. This study aimed to adapt and validate the Techno-eustress Scale for HETs. The scale was translated, adapted, and tested in a nationwide sample of 1,107 Portuguese HETs. Both exploratory and confirmatory factor analyses were used. Results led to a brief 5-item Portuguese version of the techno-eustress scale, exhibiting a one-dimensional structure and robust psychometric qualities, evidencing reliability, construct validity, and strict measurement invariance. The study provided a parsimonious techno-eustress assessment that assists future research and practice. Our work extended technostress research and crosses scientific domains such as education, psychology, information systems, and management. This brief measurement underpins positive organizational studies as it opposes the eternalization of techno(di)stress measurements, in a technology-based era when wellbeing, notably for HETs, is a precious asset.

Keywords: techno-eustress, technostress, ICT, higher education teacher, scale validation

INTRODUCTION

The expansion of Information and Communication Technologies (ICT) has evident benefits such as increased convenience, flexibility, and productivity. However, technology also brings difficulties to users, like information overload and the need for

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constant updating which has generated concerns about the impacts on physical and mental health. This source of pressure gave rise to a specific stress research stream – technostress, or ICT-induced stress - strongly suggesting that the use of technology at work can lead to harmful effects (e.g., Ayyagari et al., 2011; Brod, 1984; Tarafdar et al., 2007, 2010).

In addition to this negative view, other perspectives claim that technology might also be a source of "positive" stress. The transactional model of stress underscores that stress perception is dependent on the individual's assessment of the stressor threat level and their own resources to cope with it (Lazarus & Folkman, 1984, 1987), meaning that both negative (distress) and positive (eustress) experiences are possible. In the technological context, these experiences were differentiated as techno-distress and techno-eustress (Sethi et al., 1987). Recent developments on technostress have highlighted its positive and beneficial aspects and how they can contribute to positive workplace outcomes (Benlian, 2020; Califf et al., 2020; Tarafdar et al., 2019; Yu et al., 2023), inviting further research on how individuals experience techno-eustress and its effects.

The education sector has followed the imperatives inherent to the 4.0 Revolution. Implementing higher education's digital agenda has been producing changes and putting more pressure on one of its key players, the higher education teacher (HET). The prevalence of unplanned telework imposed by the COVID-19 pandemic's confinements increased concerns about workers' well-being in general and affected HETs. However, literature documented numerous benefits of technology use for educators (Wangdi et al., 2023), suggesting that HETs can experience ICT-induced stress positively.

Despite some recent developments (e.g., Califf et al., 2015, 2020; Zielonka & Rothlauf, 2021), research on techno-eustress has been limited compared to the attention given to techno-distress and is scarce among HETs. One reason for this disparity may be related to a shortage of techno-eustress measurement instruments. This study's objective is to offer a robust techno-eustress scale. This is valuable because it fulfills the need for researchers to work on valid measurements and contributes to leveraging the impact of techno-eustress research and the related implications for the well-being of people and organizations. To contextualize the study, stress and technostress' theoretical foundations are provided, and related existing measurements are identified.

Review of Literature

Stress, Distress, and Eustress

In 1956, Selye created the term "stress" to embody the way humans respond both physically and mentally to challenges. In the organizational setting, stress has been defined as an "overarching rubric for the domain concerned with how individuals adjust to their environments" (Quick et al., 1997, p. 2), and is important due to its impact on job satisfaction, productivity, turnover, workplace injuries, and absenteeism (Hargrove et al., 2015). Selye considered stress to be a natural response to life's challenges (Le Fevre et al., 2003), and this concept evolved later to include two types of stress: distress and eustress (Selye, 1974), embodied in the transactional model of stress and coping (Lazarus & Folkman, 1984, 1987). Cooper et al. (2001) argued that stress is cognitively appraised depending not only on the context but also on the relationship established with it, generating both positive and negative experiences.

Distress has been associated with negative stress outcomes and defined as "the degree of physiological, psychological, and behavioral deviation from an individual's healthy functioning" (Quick et al., 1997, p. 5) and it occurs when the body is unable to meet the demands (Le Fevre et al., 2003) or when the individual is unable to cope with the stressful challenge (Hargrove et al., 2015).

Conversely, eustress has been defined as "the healthy, positive, constructive outcome of stressful events and the stress response" (Quick et al., 1997, p. 4) that can lead to improved performance and other outcomes at work. Eustress arises when individuals perceive their stress from a positive lens. Workers experiencing eustress report "being totally focused on a mindful state of challenge, a healthy state of aroused attention on the task, exhilaration, and being fully present" (Hargrove et al., 2013, p. 61).

Technostress and Techno-eustress

Since becoming embedded in most work processes and tasks, ICT introduced another source of stress in job settings by increasing digital literacy demands and information workload. Brod (1984) introduced the term technostress and defined it as a disease caused by an incapacity to effectively cope with ICT. The ensuing research mainly focused on the adverse consequences for individuals' physical and mental health, organizational costs, and produced many recommendations to minimize its effects (e.g., Tarafdar et al., 2007, 2010).

However, following stress theoretical foundations and, in particular, the transactional model of stress and coping (Lazarus & Folkman, 1984, 1987), the perception of stress is determined by the individual's assessment of the threat level and their personal resources, allowing for both negative and positive experiences. This theoretical lens suggests that the individual appraises a) the environmental conditions either as a threat or a challenge (primary appraisal) and b) the available resources to respond to the stressful situation (secondary appraisal). This then sets coping responses into motion that determine the quality of the individual's functioning (negative or positive). In the ICT context, the distinction between distress and eustress (Selye, 1974) was transposed into the differentiation between techno-distress and techno-eustress (Sethi et al., 1987), conceptualized as two distinct transactional phenomena, based on threatening and challenging perceptions (Tarafdar et al., 2019). By mainly addressing the negative effects of technology, technostress literature shows a lack of empirical studies incorporating a comprehensive perspective. Nevertheless, according to the referred theoretical lens, ICT use in occupational contexts can generate positive and motivating experiences for jobholders and can lead to beneficial effects at both individual and organizational levels (Figure 1).

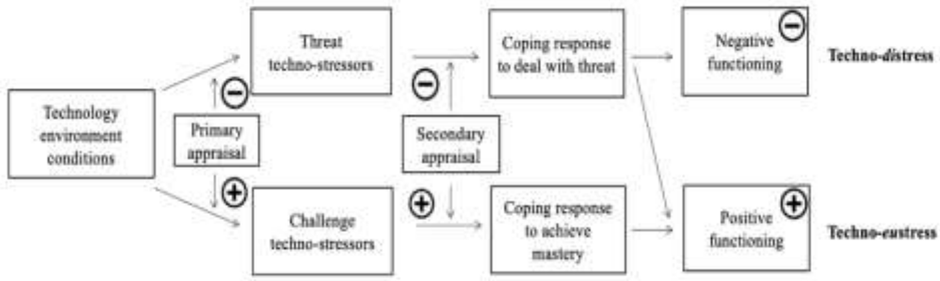

Figure 1
Techno-distress and techno-eustress

In the face of technological environmental conditions that potentially create a demand on the individual, techno-eustress is conceptualized as how and why individuals appraise it as challenging, use adequate coping strategies, experience consequent positive stress, and are provided positive outcomes (Tarafdar et al., 2019). It is, therefore, of great importance to have a scale that supports this still emergent line of research, since, as a distinct phenomenon, techno-eustress can be measured on its own.

Higher Education Teachers and Technostress

HETs play a key role in the strategic contribution to social and economic development, empowering the population with knowledge and competencies to succeed in a global economy. In the current global trend of digitalization, education has not laged in its development (Peredrienko et al., 2020). Higher education institutions worldwide have been adopting innovative technology-based formats, such as game-based learning, mobile learning, and flipped classrooms (Li & Wang, 2021). ICT transformations place new demands on HETs, and they are often not motivated enough to take the initiative to modify their teaching practices by integrating new technologies (Joo et al., 2016). In addition, the ICT-powered learning often takes more time and effort and is more complex than traditional formats (Joo et al., 2016; Wang & Li, 2019), resulting in overload, functional ambiguity, changes in work patterns, and the need for constant updates in knowledge and skills. Therefore, it is not surprising that research has been targeting the negative impacts of ICT on these professionals' functioning (Li & Wang, 2021).

The theoretical foundations of technostress allow, however, for a positive perspective on HET's ICT-induced stress. Technology can provide working tools for better performance and student engagement due to increased creativity, diversity, and tailored pedagogies and approaches (Khan et al., 2020), potentially generating favorable feelings and, therefore, stress experienced as stimulating and beneficial. Nevertheless, research focusing on HET's techno-eustress has been limited. Studying HETS' well-being is critical from both macro and micro perspectives, notably in recent pandemic times, marked by remote-imposed teaching, but also for a future where, even in face-to-face learning, ICT prevalence is likely to increase and add to the quality and efficiency of teaching (Makruf et al., 2022). Techno-eustress scales validated for the respective population are a key contribution towards that objective.

Techno-eustress Assessment

Despite prominent authors and conceptualizations strengthening the positive side of stress, the eustress concept has received much less research focus than its counterpart distress. Correspondingly, eustress measurements are scarce, highly contrasting with the ones dedicated to assessing distress, as is the case of the PSS - Perceived Stress Scale (Cohen et al., 1983), and the K10 - Kessler 10 Psychological Distress Scale (Kessler et al., 2003). Some scales emerged to holistically measure eustress and distress, mainly in adults and in organizational contexts. Of these, the Valencia Eustress-Distress Appraisal Scale (VEDAS) is probably the best-known (Rodríguez et al., 2013). To the best of our knowledge, the only exception to assessing distress or integrated distress-eustress measurements is the Eustress Scale (O'Sullivan, 2011), given that it only focuses on eustress. *Defining eustress as both the process of responding positively to stress and the positive outcome of that process*, this author took the PSS as a basis for developing and validating the scale in a sample of college students.

In the ICT context, some measurements have been developed to assess technostress but were focused on techno-distress, thus not fully capturing the changing dynamics of technology use and leading to the oversight of critical aspects. Some examples are the widely known Technostress Creators Scale (Ragu-Nathan et al., 2008), the technostressors measurements presented by Ayyagari et al. (2011), and the RED/TIC (Salanova et al., 2004). In the same vein as the stress assessment, recognizing both positive and negative sides of technostress, Cucchi (2020) devised and presented a scale to gauge the nature of the person's interpretation - techno-eustress or techno-distress. In pioneering research involving both negative and positive expressions of technostress, the O'Sullivan (2011) eustress scale was adapted to the ICT setting, and a techno-eustress scale was developed (Califf, 2015; Califf et al., 2015). In our study, this scale was translated, adapted, and validated in a representative sample of Portuguese HETs. This study addresses the lack of a dedicated techno-eustress scale in the Portuguese language, restricting its widespread utilization and hindering research on techno-eustress in Portugal.

METHOD

Sample

The sample, non-probabilistic and collected by convenience, included 1,107 complete responses (51.3% female), most from public higher education institutions (77.6%), and 67.8% had teaching as their only profession. 21.5% of the participants reported teaching experience of <10 years, 22.9% of 10-19 years, 32.5% of 20-29 years, 18.6% of 30-39 years, and 4.4% of >40 years. This sample was randomly split into two approximately equivalent samples for exploratory factor analysis (EFA, n=559) and confirmatory factor analysis (CFA, n=548) purposes. Additionally, a follow-up sample (n=712) was used to evaluate test-retest reliability.

Procedure

To the authors' knowledge, the eustress scale had never been translated, adapted, or validated in Portuguese population samples and technological workplace settings. Based on the 10-item techno-eustress scale adapted for the healthcare ICT working environment (Califf, 2015; Califf et al., 2015), items were translated into the Portuguese language, and the wording was adapted to suit the context of our study. The back-translation method was used. Instead of a literal equivalence, we identified unclear words, removed inconsistencies or conceptual errors, and reflected the semantic and cultural context of each original item (Borsa et al., 2012). To strengthen content validity, comments, and opinions were requested from two Portuguese HETs who were frequent users of ICT in their teaching. The original and Portuguese versions of the Techno-eustress Scale can be found in the Appendix. The Likert response scale was adapted from a 7-point to a 5-point format. This adjustment was made because the techno-eustress measurement would be used together with other measurements of varying response scales, within a comprehensive research study in which the standardization of Likert points was sought. Research has suggested that minor changes in response formats do not affect their validity (Judge et al., 1999). The 5-point Likert type was chosen to reduce the *status quo* effect, or the possible predisposition of participants to maintain the same response when faced with a large number of options (Vieira & Dalmoro, 2008).

Due to the intended nationwide coverage and the ease of the population's internet access, data were collected through an online survey built on Google Forms, requested by email, during 3 weeks in May-June 2020. Direct contact through the authors' networks, along with the snowballing technique, resulted in a multiplier effect across personal and digital channels. Heads of higher education institutions and/or departments were briefed and asked by email to publicize the study among their faculty members. HETs were also directly emailed through the available contacts on the institutions' web pages. All the ethical standards related to this type of study were followed and all HETs participated voluntarily. The survey also included four additional measurements for use in construct validity analysis, described in the next section.

Since scale validation implies self-report as the only measurement method, some of the procedures (e.g., caution in the item's translation and phrasing to avoid ambiguity, non-existence of right or wrong answers and confidentiality guarantee) contributed to avoiding common-method biases, or "the variance that is attributable to the measurement method rather than to the construct the measures represent" (Podsakoff et al., 2003, p. 879).

Measurements

Techno-eustress scale. This is a 10-item measurement, adapted for the healthcare ICT organizational context in a sample of nurses (Califf, 2015; Califf et al., 2015) from the O'Sullivan (2011) original scale. An example of item adaptation is "*How often do you feel that stress that stems from technology positively contributes to your ability to handle your work-related problems?*" v.s. "*How often do you feel that stress positively contributes to your ability to handle your academic problems*?". The scale assesses the degree to which stress induced by technology is perceived as beneficial or has a positive effect on the functioning of the individual (Califf et al., 2015) and revealed a

Cronbach's Alpha of .83. Items were scored on a 5-point Likert-type scale (1=never to 5=always), with higher mean scores indicating greater techno-eustress experience.

(IT) Usefulness scale. This 4-item scale was adapted from Ayyagari et al. (2011). It assesses the individual's judgment about the degree to which technology characteristics enhance job performance. An example item is "*Use of ICTs improves the quality of my work*" with responses being given on a 5-point Likert-type scale (1=strongly disagree, 5=strongly agree). Reported Cronbach's Alpha was .94.

IT Mindfulness scale. This 4-item scale is the short version of the 11-item initial measurement provided by Thatcher et al. (2018). The construct is defined as a dynamic IT-specific trait, and the scale evaluates the degree of attention given to technology in the work context, whereby the user focuses on the present, pays attention to detail, exhibits a willingness to consider other uses, and expresses a genuine interest in investigating IT features and failures. An example item is "*I like to figure out different ways of using information technologies*". Responses were given on a 5-point Likert-type scale (1=strongly disagree, 5=strongly agree) and Cronbach's Alpha was .88.

Multiple Coping Strategy Use scale. This is the 6-item Multiple coping strategy use scale, a subscale of the Self-perceived flexible coping with stress scale (Zimmer-Gembeck et al., 2018). It assesses the degree to which the individual has a wide "toolbox" of options for coping with stressors and the ability to turn to alternate coping strategies whenever needed. The scale was adapted for the ICT context and validated for Portuguese HETs by this paper's authors. An example of an adapted item is "*When I need to, I can change how I deal with stress that stems from IT use*". Participants used a 5-point Likert-type scale (1=strongly disagree, 5=strongly agree). Reported Cronbach's Alpha was .96.

Job Satisfaction scale. Respondents' levels of job satisfaction were measured by a 3-item scale assessing the pleasurable or positive emotional state that results from the appraisal of one's work or work experiences, proposed by Ragu-Nathan et al. (2008). An example item is "*I like doing the things I do at work.*", with responses scored on a 5-item Likert-type scale (1=strongly disagree, 5=strongly agree). The authors reported Cronbach's Alpha of .87.

Data Analysis

The validation of the Portuguese version of the techno-eustress scale was accomplished using IBM SPSS Statistics 27 and IBM AMOS Structural Equation Modeling 27.

Descriptive statistics were analyzed. EFA was conducted to understand the underlying factor structure. Reliability was verified by Cronbach's Alpha coefficient of internal consistency and test-retest procedures. CFA was undertaken to additionally assess construct validity, composite reliability, and measurement invariance. The goodness-of-fit indices included χ^2/df, CFI (*Comparative Fit Index*) as a measure of relative fit, GFI (*Goodness of Fit Index*), RMR (*Root Mean Square Residual*), and RMSEA (*Root Mean Square Error of Approximation*), $p \geq .05$, as absolute fit indices. MECVI (*Expected Cross-Validation Index*) was also checked as an indicator of the validity of alternative models in the population from a single sample, in which the model with the lowest found value will be the most stable in the population (Browne & Cudeck, 1993). Measurement invariance, i.e., configural (factor structure), metric, scalar, and strict (error) invariance were verified using multigroup confirmatory factor analysis.

A summary of the methods can be found in Figure 2.

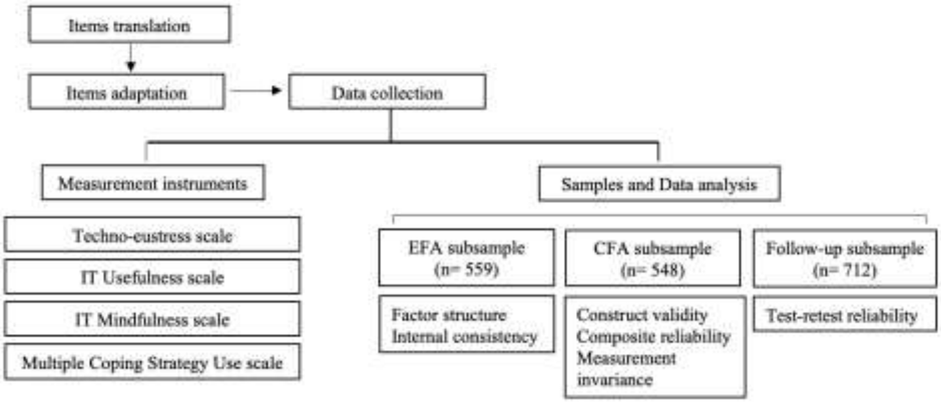

Figure 2
Summary of the methods used in this study.

FINDINGS

Preliminary Results

Data were screened for obvious unengaged responses, and outliers were verified. In 7 of the 10 items, 4 outliers were detected via boxplot inspection, but the comparison between the original mean and the 5% trimmed mean showed only minor differences, ranging from .01 to .03, so these cases were kept in the data (Pallant, 2020). The mean values of the techno-eustress scale items ranged from 2.54 to 3.73.

Regarding normality verification, the Kolmogorov-Smirnov (with Lillefors correction) test (K-S) yielded p=.000. However, in large samples (≥200) the K-S test is very sensitive, often leading to p<.05 and the effects of non-normality are negligible (Hair et al., 2019). These occurrences are common in the social sciences (Pallant, 2020). Skewness ranged from -.43 to .09 and kurtosis ranged from -.80 to .21, within the "rule of thumb values" of +/- 2.58 (Hair et al., 2019).

Data adequacy for EFA was ensured by the Kaiser-Meyer-Olkin (KMO) result of .835, qualified as good, and by the Bartlett Sphericity test, with a result of $\chi^2(45)=2434.731$; p=.000, inferior to the p<.001 recommendation (Hair et al., 2019).

Exploratory Factor Analysis and Reliability

Original studies of the eustress scale (O'Sullivan, 2011) and the techno-eustress scale (Califf, 2015) indicated a one-dimensional model. Along with the principal components extraction method, which does not require a multivariate normality (Marôco, 2018), the

Promax rotation method was used as it is oblique, allowing the extracted factors not to be independent, which is more realistic in social sciences (Hair et al., 2019), and also due to its suitability for data matrices with some dimension (Marôco, 2018).

Kaiser criterion revealed 3 factors (components) with eigenvalues >1 that explained 70.8% of the total variance but with emphasis on one factor that, alone, explained 42.45% of the total variance. The scree plot inspection showed a curve inflection at the 4th factor, but also a visible inflection pointed at the 2nd factor. Communalities were above .50 (Hair et al., 2019) in all items. Multidimensionality was analyzed by checking item factor scores, cross-loadings >.03, and internal consistency. One of the factors was discarded due to a Cronbach Alpha of .61, below the .70 cutoff (Hair et al., 2019), and because it included only 2 items (TEu6i e TEu7i), insufficient to maintain face validity and construct coverage. Moreover, both were reverse coded, which could have influenced participants' responses and scored in an independent factor.

The two-factor 8-item solution was then explored. KMO and Bartlett tests resulted respectively in .85 and $\chi^2(28)=2181.924$; p=.000, within the reference values. The variance explained by the 2-factor solution achieved 69.4%, and communalities and factorial loadings were within the thresholds. However, one item had cross-loading <.03 and internal consistency was only moderate (Cronbach Alpha=.76), therefore this solution was deemed unsatisfactory.

By taking the initial definition of the unidimensional concepts of eustress and techno-eustress, the results of an EFA with the original 10-item scale (O'Sullivan, 2011, and the starting point of the works of Califf, 2015, Califf et al., 2015, Califf et al., 2020) were analyzed forcing the extraction of a single factor. This factor explained only 42.45% of the total variance and revealed a poor factorial solution since the minimum cutoff point in social sciences is around 60% (Hair et al., 2019). Items TEu1, TEu2, and TEu5 revealed very low communalities, suggesting their removal. Items TEu6i and TEu7i showed low communalities and very low factor loadings, which was not surprising given the weaknesses previously reported. Therefore, these five flagged items were removed. Theoretically, no relevant information was lost, to the extent that eustress is operationalized by O'Sullivan (2011) through a unidimensional structure. Thus, the content of the eliminated items is represented in the remaining items. Procedures undertaken generated a suitably parsimonious scale, in line with an ideal 5-items strongly loading (≥.50) in a solid factor (Costello & Osborne, 2005).

This solution produced KMO=.84 and $\chi^2(10)$ =1565.684; p=.000 in Bartlett tests, within the reference values. The extracted factor explained almost 70% of the variance. The communalities were above .59 and the factorial loadings were quite satisfactory (between .77 and .87). Good internal consistency was achieved (.89), very close to the 'very good' threshold. The main results from EFA can be found in Table 1.

Table 1
Techno-eustress scale final EFA results

Item	Mean	SD	λ	h^2	Cronbach α
TEu3	2.88	1.05	.77	.59	
TEu4	2.61	1.08	.83	.70	
TEu8	2.54	.98	.86	.74	.89
TEu9	2.86	1.05	.80	.64	
TEu10	2.59	1.07	.87	.76	
Eigenvalue	3.431				
% variance	68.630				

Note. SD – standard deviation, λ-item factor loading, h^2–communalities.

To verify test-retest reliability, the recommended time gap is about 15–30 days. However, in our case, data were obtained from a subsample of 712 participants who completed the techno-eustress scale nine months later in another investigation in which the difference between time 1 and time 2 administrations was designed to be higher. Results showed moderate, statistically significant correlations between participant scores across the two administrations ($r=.57$; $p<.001$). Since a longer time gap is associated with a lower expected correlation, the moderate level of correlation achieved suggests temporal stability.

The different factorial solutions tested with EFA strongly indicated that the 5-item unidimensional measurement model granted the best theoretical and statistical consistency.

Confirmatory Factor Analysis

CFA was conducted on the 5-item unidimensional scale. Normality was verified through skewness $|Sk|\leq.211$ and kurtosis $|Ku|\leq.838$ parameters, within the recommended limits of $|Sk|<2$ and $|Ku|<7$ (Finney & DiStefano, 2006).

Much better goodness-of-fit indices were obtained when correlating TEu3 and TEu4 residuals, as suggested by the modification indices, and theoretically supported since the errors are part of the same factor. Good adjustment quality was obtained in all indices, as $\chi^2/df=1.319$, CFI=.999, GFI=.996, RMR=.012, RMSEA=.024, P[rmsea<=.05]=.761 (Hair et al., 2019). MECVI=.050, considerably lower than the ones found in the 10-item 3-factor scale (.375) and the 8-item 2-factor scale (.216), indicating that the 5-item unidimensional scale is the model that will present better validity in the population.

Factorial validity was confirmed by item factor loadings higher than the .50 threshold ($\lambda_{TEu3}=.71$; $\lambda_{TEu4}=.76$; $\lambda_{TEu8}=.84$; $\lambda_{TEu9}=.73$; $\lambda_{TEu10}=.89$), or similarly, all item reliabilities ($R^2_{TEu3}=.51$; $R^2_{TEu4}=.58$; $R^2_{TEu8}=.71$; $R^2_{TEu9}=.53$; $R^2_{TEu10}=.79$) were >.25 (Hair et al., 2019). Convergent validity was verified through average variance extracted (AVE) of .63, above the .50 cutoff, and composite reliability achieved .89, comfortably higher than the .70 threshold (Fornell & Larker, 1981; Hair et al., 2019). Figure 3 shows CFA results.

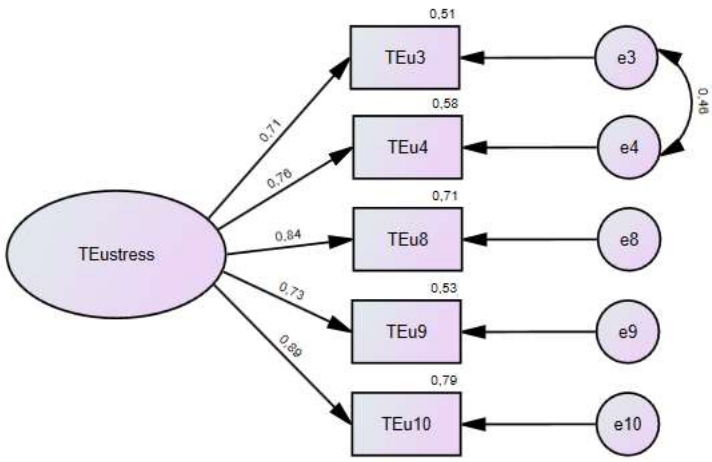

Figure 3
Techno-eustress scale CFA results

To test discriminant validity, measurements of four work setting-related, non-stress constructs were used: (IT) Usefulness, IT Mindfulness, Multiple Coping Strategy Use, and Job Satisfaction (Table 2). These constructs were chosen since they share a conceptual and theoretical basis with the stress experience and because their relationships with stress or ICT-induced stress were empirically demonstrated (e.g., Ayyagari et al., 2011; Califf et al., 2015; Ioannou & Papazafeiropoulou, 2017; Ragu-Nathan et al., 2008; Zimmer-Gembeck et al., 2018).

The comparison between AVE's square root and the correlations (Pearson's *r*) between the factors shows that, in all cases, √AVE>Max *r*, thus meeting the Fornell-Larcker criterion. Also, maximum shared variance <AVE (Hair et al., 2019). Furthermore, all correlations were below .80, indicating that the techno-eustress scale is distinct from the other four measures of related, non-stress constructs (Campbell & Fiske, 1959).

Table 2
Technoeustress scale's discriminant validity

Scales	AVE	MSV	Usef	ITM	Cop	JSat	TEu
Usef	.76	.21	.87				
ITM	.60	.28	.46***	.77			
Cop	.78	.24	.30***	.49***	.88		
JSat	.65	.13	.23***	.34***	.36***	.81	
TEu	.63	.28	.40***	.53***	.44***	.17***	.79

Note. Usef - IT Usefulness, ITM – IT Mindfulness, Cop – Multiple Coping Strategy Use, JSat – Job Satisfaction, TEu – Technoeustress, AVE – Average Variance Extracted, MSV – Maximum Shared Variance. Square-root of the AVEs is reported in bold along the diagonal of the correlation of constructs. ***p<.001.

In addition to the MECVI index, after creating two different random samples (5:5), measurement invariance was tested by using sequential chi-square difference tests in increasingly restrictive cross-groups imposed constraints (Cheung & Rensvold, 2002).

The models used were: unconstrained; fixed measurement weights; fixed measurement intercepts and covariances; and fixed measurement errors. The factorial model showed good fit simultaneously in both subsamples, demonstrating its configural invariance, as shown by χ^2/df =.862; CFI=1.000; GFI=.988; RMSEA=.0000; I.C. 90%].000; .032[. The constrained model with factor weights (λ), intercepts (i) and variances/covariances (Cov), and error or residuals (ε) fixed on both subsamples did not show a significantly worse fit than the model with free parameters, as $\Delta\chi^2_{\lambda}(4)=.827$; p=.935 and $\Delta\chi^2_{i}(5)=10.989$; p=.052; $\Delta\chi^2_{Cov}(1)=.126$; p=.723; $\Delta\chi^2_{\varepsilon}(6)=9.459$; p=.149. Therefore, metric, scalar, and even the restrictive measurement error invariance of the 5-item techno-eustress scale was demonstrated, indicating that response differences are not due to artifacts of the scale's performance across groups.

In summary, results from CFA on the 5-item scale revealed construct validity, reliability, and strict measurement invariance, suggesting a robust measurement.

DISCUSSION

Stress and technostress are not inherently maladaptive. Theoretical foundations and recent research on technostress voice the need to deepen its "bright side," yet techno-eustress measures are scarce. This paper presented the translation, adaptation, and validation of the Portuguese version of the Techno-eustress Scale, based on O'Sullivan's Eustress Scale, for the HET population.

The instrument comprised of 5 items was found to have had the best factor structure. The factor identified through EFA accounts for a considerable percentage of the overall variance, supporting the assumption of a unidimensional construct. The quality of the theoretical model's fit to the data was deemed adequate. The results revealed suitable levels of reliability and construct validity and provided evidence of robust psychometric properties. In addition, the scale was tested in two broad random subsamples from the same population, attesting to factor structure, metric, scalar, and strict invariance. This scale can, therefore, be considered valid in Portuguese HETs and is, to the best of our knowledge, the first techno-eustress measurement for the Portuguese population.

Some theoretical and practical contributions surface in this study. The observed one-dimensionality aligns with the conceptual definition and the original scales as initially postulated and operationalized by O'Sullivan (2011) in the Eustress Scale and by Califf (2015) in the Techno-eustress Scale.

Another convergence with the literature is that our results in the HETs' sample are in line with those of Fonseca and Jordão (2014), who adapted and validated O'Sullivan's eustress scale in a sample of Portuguese teachers from all educational levels. Notably, the 5 items found are the same, although they are not within the context of the technological environment. Conversely, the comparison with the 3-item scale that resulted from Califf's (2015) validation study reveals the coincidence of only two items. This disparity could be associated with differences in the target population, such as occupation and context (organizational and national) since Califf's sample was comprised of nurses from American hospitals.

This study contributes to the assessment of positive stress derived from the use of technology in organizational settings in several ways. It not only adds to research emphasizing individuals' active role in interpreting and reacting to stressful technological situations, but it also enhances potential beneficial effects. Moreover, this scale, unlike O'Sullivan's original, is specifically tailored for adults in the work setting. Offering positive technostress measurements is crucial to addressing the ongoing lack of techno-eustress research. Furthermore, the scale's concise length provides a solid yet parsimonious assessment for practitioners and future research.

Some limitations should temper this study's results. Given that self-report was the only measurement method used, and despite the precautions taken during the translation and adaptation, common-method biases could not be fully accounted for. Since this study targeted a particular population, HETs, direct transfer of the results to other occupational contexts should be considered with caution. In addition, data collection occurred during the COVID-19 pandemic which was a unique experience of our time.

CONCLUSION

This research advances the understanding of the positive aspects of technostress. The techno-eustress scale was found to be a brief and psychometrically robust measurement for the evaluation of the Portuguese HET's techno-eustress. It maintains a one-dimensional structure, as does the original eustress assessment instrument. It is simple to administer and score due to its practicality and short application time and is, therefore, suitable for general practice and more efficient research. The translation and adaptation offer a basis for its use in the other eight Portuguese-speaking countries and ease further validation procedures. This scale is expected to be used to deepen the investigation of techno-eustress, a relevant dimension of individual and organizational wellbeing. Our work is interdisciplinary, linking education, psychology, information systems, and management. New investigation avenues can build upon these foundations to further explore the assessment and implications of techno-eustress. First, future studies may seek to use time-lagged data collection or identify the techno-eustress scale with non-self-report measures, such as supervisor reports. Second, it would be desirable to extend the techno-eustress scale validation to other differentiated groups, to the general Portuguese population, or to other nationalities and cultures, including, but not limited to Portuguese-speaking countries. Third, complementary investigation paths could explore techno-eustress measurements beyond ICT job use.

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APPENDIX

Table A
Portuguese version of the Technoeustress Scale

Item	Technoeustress Scale English (Califf, 2015; Califf et al., 2020)	Portuguese
TEu1	How often do you effectively cope with stressful changes that occur because of technology in your work life?	Com que frequência lida eficazmente com mudanças stressantes que ocorrem devido ao uso das TIC na sua vida profissional?*
TEu2	How often do you deal successfully with irritating work hassles that occur because of technology?	Com que frequência lida com êxito com complicações de trabalho irritantes que ocorrem devido às TIC?*
TEu3	How often do you feel that stress that stems from technology positively contributes to your ability to handle your work-related problems?	Com que frequência sente que o stress originado pelas TIC contribui positivamente para a sua capacidade de lidar com os problemas de trabalho?
TEu4	In general, how often do you feel motivated by your stress that stems from technology?	Em geral, com que frequência se sente motivado pelo stress que advém da utilização das TIC no trabalho?
TEu5	In general, how often are you able to successfully control the irritations that stem from technology in your work life?	Em geral, com que frequência é capaz de controlar com êxito as irritações profissionais originadas pelas TIC?*
TEu6i	In general, how often do you fail at work when under pressure that stems from technology?	Em geral, com que frequência falha numa tarefa profissional quando está sob pressão causada pelas TIC?*
TEu7i	In general, how often are you unable to control the way you spend your time on technology-related work?	Em geral, com que frequência se sente incapaz de controlar a forma como gasta o seu tempo em trabalhos ligados às TIC?*
TEu8	When faced with technology-related stress, how often do you find that the pressure makes you more productive at work?	Perante um stress relacionado com as TIC, com que frequência acha que essa pressão o/a torna mais produtivo/a no trabalho?
TEu9	How often do you feel that you perform better on a task involving technology when under work pressure?	Com que frequência sente que, quando está sob pressão de trabalho, desempenha melhor uma tarefa se envolver as TIC?
TEu10	How often do you feel that stress at work that stems from technology has a positive effect on your performance?	Com que frequência considera que o stress originado pelo uso das TIC tem um efeito positivo no seu desempenho profissional?

Note: i = reverse coded. (i.e., higher scores on these items imply lower technoeustress); * = item removed during EFA