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ORIGINAL

Validation of the RED-Technostress Scale in the Cuban workers from IT Sector

Validación de la Escala RED-Tecnoestrés en trabajadores cubanos del sector informático

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ABSTRACT

Introduction: the RED-Technostress Questionnaire evaluates the real distortions in the interaction of adult users of technologies. It has not been adapted or validated for the Cuban context.
Method: in this work this questionnaire is validated in workers of the Cuban IT sector. Expert consultation, concordance coefficients and factor analysis were carried out to determine reliability and validity.
Results: the content validity coefficient ($\geq 0{,}70$) shows the relevance of all the items according to 8 experts, who made observations to improve the wording. In piloting, 37 people participated and adequate reliability was obtained ($\alpha = 0{,}832$). In the application 141 people participated and high overall reliability was obtained ($\alpha = 0{,}761$), as well as by dimensions, Fatigue ($\alpha = 0{,}874$), Anxiety ($\alpha = 0{,}741$), Inefficacy ($\alpha = 0{,}792$) and Addiction ($\alpha = 0{,}744$). In the Skepticism dimension, an inadequate value was reached ($\alpha = 0{,}249$). The exploratory factor analysis partially reproduced the dimensional structure. The confirmatory factor analysis obtained a good model fit.
Conclusions: the evaluated questionnaire has adequate psychometric properties of reliability and validity for the Cuban context.

Keywords: Test Adaptation; Technoestres; Validation; CITs.

RESUMEN

Introducción: el Cuestionario RED-Tecnoestrés evalúa la disfunción real en la interacción en adultos usuarios de las tecnologías. Este no ha sido adaptado ni validado para el contexto cubano.
Método: en este trabajo se valida este cuestionario en trabajadores del sector empresarial informático cubano. Se realizaron consulta a expertos, coeficientes de concordancia y análisis factorial para determinar la fiabilidad y validez.
Resultados: el coeficiente de validez de contenido ($\geq 0{,}70$) demuestra la pertinencia de todos los ítems según 8 expertos, que realizaron observaciones para mejorar la redacción. En pilotaje participaron 37 personas y se obtuvo adecuada fiabilidad ($\alpha = 0{,}832$). En la aplicación participaron 141 personas y se obtuvo alta fiabilidad global ($\alpha = 0{,}761$), así como por dimensiones, Fatiga ($\alpha = 0{,}874$), Ansiedad ($\alpha = 0{,}741$), Ineficacia ($\alpha = 0{,}792$) y Adicción ($\alpha = 0{,}744$). En la dimensión Escepticismo se alcanzó un valor inadecuado ($\alpha = 0{,}249$). El análisis factorial exploratorio reprodujo parcialmente la estructura dimensional. El análisis factorial confirmatorio obtuvo un buen ajuste del modelo.
Conclusiones: el cuestionario evaluado posee adecuadas propiedades psicométricas de fiabilidad y validez para el contexto cubano.

INTRODUCTION

Technology has generated modifications in the habits and organization of work, both from an ergonomic and psychosocial point of view.[1,2] The widespread use of computer media, labor flexibility and the implementation of teleworking due to the COVID-19 pandemic, implied a new way of relating and communicating through Information and Communication Technologies.[2,3,4]

While their use can improve the efficiency of processes, it can also generate problems in the cognitive-work environment of the worker.[2,5] Among these problems is stress. Specifically related to the use of technologies appears technological stress or Technostress (TS), which is defined as the negative impact of attitudes, thoughts, behaviors or body physiology, caused directly or indirectly by technology.[2,4,6]

The TS began to be studied in 1982 and has been of interest in Latin America and Cuba.[2,7] It was first defined by Brod as "a modern adaptive illness caused by an inability to cope with or deal with new computer technologies in a healthy way, being the product of a combination of anxiety, information overload, role conflict and organizational factors".[8,9,10,11,12,13]

For Salanova et al.[14] TS is the result of a perceptual process of mismatch between demands and available resources, characterized by affective symptoms or anxiety and by the development of negative attitudes towards ICTs.

Ragu-Nathan et al.[15] and Tarafdar et al.[16] provided instruments to measure the most commonly used ST creators and inhibitors in modern research on this topic, which is essential when proposing strategies to manage a problem that is increasingly present in organizations.

There are also several articles that carry out sociodemographic studies to determine how different factors such as age, gender, education or personal traits can be found related to the TS.[17]

In Cuba, no research has been reported that validates the questionnaire of the Resource Scale Experiences/ Emotions and Demands-Information and Communication Technologies (RED-Tecnoestress), developed by the *WONT* Psychosocial Prevention Research team of the University Jaime I of Castellón.[18] The authors have previously carried out the content validation of this questionnaire.[19]

The aim of this research is to validate the RED-Technostress Questionnaire from Llorens et al.[18] in workers of the Cuban IT business sector. For this purpose, the fundamental results of the content validation will be summarized and then the psychometric properties of the test (reliability and construct validity) will be presented after its application.

METHOD

The research classifies as technological development work type I+D+i.[20] It culturally adapts the RED-Technostress Questionnaire, followed by its validation.

The adaptation of the instrument went through the following phases: selection of experts, validation by the committee of experts (content validity), pilot study (for preliminary validation) and application. A mixed methodology was used, with emphasis on quantitative aspects.

A form was prepared for the cultural adaptation process with the participation of eight experts, who were contacted electronically and asked for their informed consent, their technical data sheet and the questionnaires were sent to them.

The form included a section dedicated to collecting the personal and professional data of the experts/ specialists, the objective of each evaluation was described, as well as the questionnaire, its structure and an answer sheet according to the evaluated criteria: semantic, conceptual and experiential equivalence. In order to standardize the evaluation process, the criteria were defined, as well as the way in which they were to be evaluated.

The following inclusion criteria were considered: to have served as a professional for 10 years or more in organizational and clinical psychology; to have undergraduate or graduate academic training in psychology (predominantly organizational psychology); to belong to national groups or scientific societies related to organizational and clinical psychology. In the case of linguistic experts, it was considered to be a graduate of a degree in Spanish from a Pedagogical University or a degree in Philology; to have worked in teaching or research activities for the development of the Spanish language for 10 years or more.

The sample consisted of four doctors of science, two masters of science and two bachelors, with at least 15 years of experience, with an average of 35,5 ± 13,4. It included professors, researchers and retirees from different institutions such as Faculty of Arts and Letters, FLACSO-Cuba and Faculty of Psychology, belonging to the University of Havana, Institute of Literature and Linguistics "José Antonio Portuondo Valdor", Center for Academic Development on Drug Addictions, National Institute of Workers' Health and the Faculty of Medical

Sciences "Miguel Enríquez", University of Medical Sciences of Havana; with specialists in Spanish Grammar, Lexicography, teaching, research, Discourse Analysis, Communication and Politics, Interdisciplinary Studies in Social Sciences and Humanities, Lexicography, psychosocial research, linguistics, Occupational Health, Research Methodology, statistics applied to psychology, construction of measurement instruments, organizational psychology, Drug Abuse and Addictive Disorders.

To statistically process the data, a spreadsheet was prepared for the content validity process, taking as a reference the methodological proposal made by Escobar and Cuervo.[21]

A pilot test was applied to a sample of 37 individuals to explore comfort, clarity, comprehension and length. A purposive sampling was carried out with developers from the Cuban IT business sector who were accessed through the snowball method, starting from an initial list of developers. These, in turn, invited other colleagues to participate in the study.

The pilot study sample consisted of 37 people, with a predominance of men (24, 64,9 %), workers belonging to productive areas (28, 75,7 %), face-to-face work (23, 62,2 %) and university students (30, 81,1 %). The average age of the participants was 34 ± 8,55, ranging from 23 to 60 years, and a mean number of years of experience of 10,1 ± 9,00 was reported, with a maximum value of 37 years.

The collection of information during the piloting was carried out *online* using *Google Form* to participants who met the inclusion and exclusion criteria.[22] The piloting included closed questions on aspects such as comfort with the questions, comprehension, clarity, willingness to answer the questionnaire, among others.

In the application, a purposive sampling was carried out with software developers from the Cuban IT business sector who were accessed through the snowball method, starting from an initial list of developers. These, in turn, invited other colleagues to participate in the study. People who did not systematically use computer media as a fundamental tool in their daily work, and people who refused to participate in the study were excluded.

Included were 141 workers from companies in the information technology sector such as the Cuban Telecommunications Company (ETECSA), the University of Informatics Sciences (UCI), Development of Technology and System Applications (DATYS), Directorate of Technologies and Systems (DTS), Union of Cuban Informatics (UIC) and the Information Technology, Automation and Communications Company Tecnomática, of Havana.

The data collection was carried out *online* in *Google Form* where sociodemographic data were collected, such as age, gender, modality of work, areas in which they worked and seniority.

The sample of the application phase consisted of 141 people, with a predominance of women (73, 51,8 %), workers belonging to productive areas (100, 70,9 %), face-to-face work modality (88, 62,4 %) and university students (100, 70,9 %). The average age of the participants was 42,1 (SD = 14,1), ranging from 18 to 78 years, and a mean number of years of experience of 12,5 (SD = 11,5) was reported, with a maximum value of 46 years.

The data was processed on a personal computer using the jamovi software,[23] where a database was created. Exploratory data analysis through descriptive statistics helped identify and correct errors. Summary measures included the arithmetic mean and standard deviation for quantitative variables, and percentages for qualitative ones.[24] Cronbach's α was calculated for internal consistency, alongside the content validity coefficient (CVC) using R programming.[24,25] Construct validity was assessed via exploratory factor analysis (EFA) with KMO and Bartlett's test conducted beforehand. Confirmatory Factor Analysis (CFA) utilized WLSMV-R with a polychoric matrix for ordinal data.[26,27] Ethical considerations included informed consent, confidentiality, and adherence to the Declaration of Helsinki.[28] This research formed part of a master's thesis approved by the Academic Committee at the University of Medical Sciences of Havana.

RESULTS

A content validity analysis was conducted from a quantitative point of view, using the four attributes of clarity, coherence, relevance and sufficiency,[21] calculating the content validity coefficient (CVC) proposed by Pedrosa et al.[29] and from the qualitative point of view, the observations given by the eight experts were systematized.[19]

In most of the items, the CVC exceeded the cut-off point to be considered adequate (0,70). For the Clarity indicator, items 3, 4 and 13 obtained CVC scores considered as unacceptable and deficient, due to observations made by the experts mentioned below in the qualitative analysis performed. For the Relevance and Coherence indicators, only item 3 obtained a poor value because most of the experts made observations on it. The inadequate CVC scores of the indicated items because the CVC in the corresponding dimensions to take unacceptable values. The overall CVC for sufficiency (0,79), clarity (0,72), relevance (0,75) and coherence (0,74) took acceptable values.

The reliability analysis reported a high value of *Cronbach*'s α = 0,832, as well as by dimensions: the Skepticism = 0,789, *Fatigue* = 0,794, *Anxiety* = 0,718, *Inefficacy* = 0,754 and *Addiction* = 0,701.

Taking into account the opinion of the participants in the pilot, two levels of the response scale were changed, replacing the word "None" with "Never" and the modifications were made.

In the application phase, the average test score ranged from 18 to 95 points, with a mean of 47 (SD = 12,7). The average score for the Skepticism dimension ranged from 5 to 23, with a mean of 12 (SD = 2,71). For the Fatigue dimension, the mean score ranged from 0 to 20 with a mean of 6,58 (SD = 4,78). The Anxiety dimension took values between 0 and 18 with a mean of 5,06 (SD = 4,06). The mean score for the Inefficacy dimension ranged from 0 to 20 with a mean of 4,70 (SD = 4,21). For the Addiction dimension, the total score ranged from 3 to 36 with a mean of 18,7 (SD = 6,44).

The reliability analysis showed acceptable values with an overall Cronbach's alpha of 0,761, as well as for the dimensions Fatigue (α = 0,874), Anxiety (α = 0,741), Inefficacy (α = 0,792) and Addiction (α = 0,744). In the case of the Skepticism dimension, an inadequate value of α = 0,249 was reached. This suggests that the items with the greatest difficulty in measuring the construct are those related to attitudes of indifference and skeptical reactions.

This dimension should be evaluated in subsequent research because nowadays the transformation and development of technologies are advancing rapidly and users are increasingly interacting with these media, which may become less important in the future, since if it is repeated, it could be communicated to the authors so that they can make their evaluations.

The item elimination analysis showed that by eliminating items 1, 2, 3, 18, 19 and 21 the reliability of the test increases slightly, which indicates that the test would present a better internal consistency without these items, as well as item 18 shows that it does not contribute much information to the test statistically. When performing this analysis by dimensions in the Skepticism dimension, we confirm that eliminating item 2 increases the α to 0,261, the other dimensions remain below the value that it yielded by dimension, except for addiction, which increases to a value of 0,774 when item 17 is eliminated.

The exploratory factor analysis was performed using the method of minimum residuals with *oblimin* rotation, and determined the grouping of 22 items into 5 factors. The analyses prior to the application of the PA indicated that the Kaiser-Meyer-Olkin index obtained (KMO = 0,801) showed strong partial correlations between pairs of variables, which suggested the relevance of using the Exploratory Factor Analysis (EFA) statistical method; Meanwhile, Bartlett's Test of Sphericity, whose results were significant ($X^2(231) = 1417$, $p < 0,001$), rejects the null hypothesis that the correlation matrix is an identity matrix, thus corroborating the relevance of the method used, indicating that the application of factor analysis to the sample data was appropriate.

These results allowed us to validate the instrument through construct validity. The hypothesis of the multifactorial or multidimensional structure of five latent factors of the adapted RED-Technostress Questionnaire was contrasted by reducing variables to factors through the method of minimum residuals with *oblimin* rotation.

Five factors were selected to explain 53,5 % of the total variance. Table 1 shows that the first factor accumulates 15,59 % of the variance. In this factor, items 5-9 and 17 are strongly correlated. Items 5-8 are grouped in the same dimension, coinciding with the original test (Fatigue Dimension). Item 9, despite belonging in the original test to the Anxiety dimension, has a high conceptual relationship with the items of the Fatigue dimension (items 5-8), which is reflected in its high correlation (0,667) with the rest of the items of the factor. Item 17 is included in this factor, but has a high uniqueness value (0,814) and low correlation (0,238) with the rest of the items of the factor, suggesting little relevance or contribution of the item to the factor model. In sum, this factor could be called Fatigue, coinciding with the homonymous dimension of the original test.

The second factor accounts for 13,17 % of the variance, which as a cumulative variance amounts to 28,8 %. It is strongly correlated with items 10, 11 and 13-16. In this factor, the items of the Anxiety and Inefficacy dimensions of the original test are mixed. The same anxiety leads to skeptical attitudes and ineffectiveness beliefs regarding the use of technologies, which can also produce negative emotions, for example, fatigue or mental and cognitive exhaustion and exhaustion due to the continued use of ICTs. Therefore, this factor can be referred to as Anxiety-Inefficacy.

The third factor represents 10,18 % of the variance and correlates with items 19 to 22. Note that in these three factors 38,9 % of the variance is accumulated. This factor includes the items of the Addiction dimension of the original test, with the exception of items 17 and 18 that appear with low correlations and high uniqueness in factors 1 and 5, respectively, suggesting little relevance or contribution of these items to the factorial model. Thus, this factor can be called Addiction, as in the original test.

The fourth factor reaches a variance of 9,07 % and accumulates 48,00 %. It correlates with items 1, 2 and 18. The first two items belong to the Skepticism dimension of the original test, while item 18 belongs to the Addiction dimension. Precisely this last item presents low correlation with the rest of the items in the factor and high uniqueness, which suggests its low relevance or contribution to the factorial model. This factor can be called ICT capacity and competence. Finally, the fifth factor represents 5,50 % of variance, accumulating 53,5 %. It shows correlations with items 3 and 4. These items belong to the Skepticism dimension of the original test.

This factor can be called Indifference to the use of ICTs. Together, the fourth and fifth factors make up the Skepticism dimension of the original test. In general, it can be stated that the results of the AFE show that compared to the original test, the factor structure of the RED-Technostress Questionnaire could be partially reproduced, hence the instrument is considered to have construct validity.

Table 1. Factor Loadings						
	Factor					**Uniqueness**
	1	**2**	**3**	**4**	**5**	
Item 1				0,829		0,334
Item 2				0,793		0,255
Item 3					0,516	0,695
Item 4					0,796	0,360
Item 5	0,745					0,415
Item 6	0,755					0,427
Item 7	0,902					0,212
Item 8	0,814					0,279
Item 9	0,667					0,400
Item 10		0,462				0,605
Item 11		0,694				0,452
Item 12						0,552
Item 13		0,822				0,328
Item 14		0,553				0,517
Item 15		0,713				0,399
Item 16		0,372				0,716
Item 17	0,238				0,206	0,814
Item 18				0,418		0,669
Item 19			0,612			0,532
Item 20			0,731			0,419
Item 21			0,811			0,339
Item 22			0,644			0,511

Confirmatory factor analysis (CFA) was used to corroborate the consistency of the factors previously identified (Figure 1). A good fit of the five-factor model was obtained in the participatory sample: $X^2(199) = 682$, $p < 0,001$; CFI = 0,938; RMSEA = 0,132, 95 % CI = (0,121, 0,123), $p < 0,001$. In addition, the regression weights for each item - were between moderate (> 0,40 and < 0,59), high (> 0,60 and < 0,79) and very high (< 0,80).

A comparison between the original model and the proposed model was carried out, allowing us to demonstrate the validity of the internal structure of the instrument by means of the CFA, analyzing its similarity with the theoretical model proposed by Llorens et al.[18]

In sum, the results of the CFA show that the factorial structure of the RED-Technostress Questionnaire could be reproduced compared to the original test, hence the instrument is considered to have construct validity.
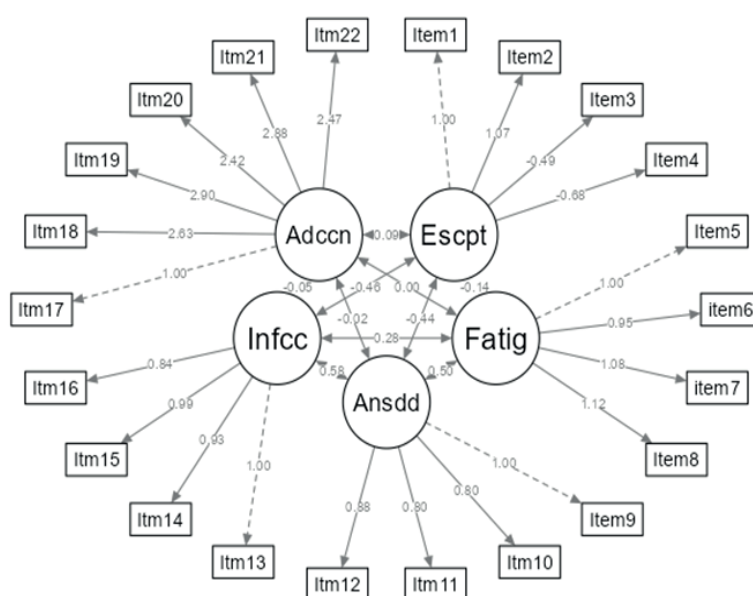

Figure 1. Confirmatory factor analysis of the adapted RED-Technostress Questionnaire

DISCUSSION

The results obtained in the attributes, acceptable and adequate, show that the items have adequate syntax and semantics that facilitate their comprehension (Clarity), have a logical relationship with the concept being measured and these should be included for their measurement (Coherence and Relevance, respectively) and that the items belonging to the same dimension are sufficient to obtain its measurement (Sufficiency).

Taking into account the observations of the experts, all the items of the original scale were modified to the cultural context.

It is pertinent to clarify that, although it is not permissible for the adapting and validating team to eliminate or add items to an instrument - this is the responsibility of its authors - it is valid to carry out this type of evaluation to decide whether the instrument is used in the new context.

With regard to the results of the pilot study and, considering the scales obtained in a Spanish normative population where the original test was validated for the first time on average,[30] the participants of the pilot study showed medium (high) values of Skepticism and Fatigue; high levels of Anxiety, Inefficacy and Addiction. This aspect should be analyzed when the application is carried out on a larger sample.

It is also observed that a high reliability of the test was obtained since the values obtained are close to those reported during the original validation mentioned,[30] which reached *Cronbach*'s α for *Skepticism* = 0,82, *Fatigue* = 0,94, *Anxiety* = 0,83, *Inefficacy* = 0,87 and *Addiction* = 0,85.

The Cuban version of the RED-Tecnostress questionnaire is valid in terms of content and reliable for measuring TS in workers in the IT sector in Havana, since it has adequate psychometric properties, which is why it is important to make known the consequences of the use of ICTs, whether due to work overload, changes in the schedule or environment, as well as the constant use outside or inside the workplace, resulting in TS, which is currently considered a phenomenon that, like stress, affects workers and can be measured with the instrument adapted for the research.

Unlike other psychometric studies on TS, the present research has a content validity analysis using the CVC, not reported in the studies reviewed. Likewise, it offers a new tool for future studies in Cuba, after an adequate validation in a larger sample, an aspect that will be worked on in the near future.

CONCLUSIONS

The RED-Technostress instrument demonstrated adequate content validity, with expert feedback enhancing item wording. A pilot study involving 37 participants confirmed the instrument's reliability and homogeneity. Participants' feedback further refined the wording of the questions. Test-retest reliability analysis indicated acceptable reliability across most dimensions, except for Skepticism, achieving partial replication of the test's dimensional structure.

The adapted RED-Technostress questionnaire, validated in our country, shows strong psychometric properties and is suitable for assessing technostress among workers in the Cuban computer sector. However, further validation with a larger sample is recommended to confirm its reliability and construct validity.

This validated instrument can identify risk factors like technostress (TS) within organizations, aiding socio-psychological analysis and serving as a reference for future TS research in Cuba, where such studies are scarce. To enhance the scale's validity, it is suggested to conduct studies with diverse professional categories, develop criteria for classifying subjects within the scale's dimensions, and explore TS processes further. Longitudinal studies examining relationships between scale dimensions and their antecedents and consequences are also recommended to deepen understanding of technostress.

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CONFLICT OF INTEREST
The authors declare that there is no conflict of interest.

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