Validation of the scale for assessing depression and its relation to technology dependence

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ABSTRACT

BACKGROUND: The daily coexistence with the technologies (computer, mobile phone, tablet, among others), begins to produce significant changes in human behavior. We have observed that there is an association between dependence on technologies and major depressive disorder, as well as with other mental disorders.

OBJECTIVE: To validate a scale for assessing depression and its relation to dependence on everyday technologies.

METHODS: Validation of a Technology Dependent Depression Scale (TDDS) was performed in 5 phases: (1) initial scale construction with 20 questions; (2) expert evaluation; (3) application to 100 volunteers, (4) statistical analysis and results, (5) preparation of the final version of the validated TDDS.

RESULTS: We used the R statistical program, version 3.4.2 and the "dplyr" package to present descriptive statistics, hypotheses tests of mean differences and factorial analysis. The results provided a validated and approved final version for TDDS.

CONCLUSIONS: We constructed the final version of the validated TDDS, which is adequate for clinical contexts and to be used in future research. All the psychometric properties were checked for accuracy, reliability, presentation, clarity, pertinence and comprehension of the instrument conferring validity to the end-product.

KEYWORDS: Digital dependence; major depressive disorder; depression; social networks; technologies.

■ INTRODUCTION

Computers, cell phones, tablets, among other technologies (CCPT&O) are modifying the interactions of individuals with the world and creating a new social dynamic scenario.[1] We live in the digital age where the proper use of technologies can bring benefits to the individual in several segments of life.[1] Unfortunately, abuse use of technologies, can lead to dependence,[2] often associated with mental disorders,[3] such as major depressive disorder (major depression), among others.

Digital dependence[2] is the lack of complete autonomy or lack of independence to perform tasks without the use of digital communication devices such as the Internet, cell phone, tablet, social networks, etc.

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM - IV),[3] Major Depression or Unipolar Depression is a psychiatric disease capable of causing numerous physical and psychological symptoms. The most common symptoms are profound sadness, irritability, anguish, tiredness, loss of pleasure, apathy, lack of motivation, low self-esteem, loss or increase of appetite, suicidal thoughts that may be present in mild, moderate and severe degrees.[3]

Depressed Individuals may have difficulty in establishing and maintaining relationships in the real world due to feelings such as insecurity, shyness and low

self-esteem;[4] so they tend to confine themselves to virtual contacts.

Professionally, we come across individuals with major depression who seek to make contacts through the Internet in order not to feel lonely and also to feel inserted in some kind of context.[5] However, because of low self-esteem and because they do not feel accepted and valued, they often create a false profile of themselves in the social networks.

According to Guedes et al,[6] the use of Facebook becomes excessive insofar as social networks become a resource for the individual to avoid contact with uncomfortable feelings, such as loneliness, stress, anxiety and depression.

The association between technology dependence[7] and technology dependent depression can develop in two ways. Some people with major depression (various symptoms present) can resort to the internet and social networks in an attempt to reduce these symptoms, mainly of solitude and social isolation. For others, technology dependence comes first: these people would already be heavy (daily, for many hours) technology users and become depressed because they "believe" that the lives of others they "meet" in social networks is much better than theirs. There are usually people who believe in everything they see posted.

The purpose of this study is to create and validate a scale for assessing depression and it's relationship with technology dependence (TDDS) and to better identify individuals with major depression, to provide specific treatment, guidelines for the conscious use of technologies, as well as to aim at a reduction of symptoms and dependence.

■ MATERIALS AND METHOD

TDDS validation was performed in 5 phases: (1) initial scale construction with 20 questions, (2) expert assessment, (3) scale application to 100 volunteers, divided into a Main group (50 participants with major depression and abusive use of technology), and a Control group (50 participants without major depression), (4) statistical analysis and results, and (5) preparation of the final validated version.

For a scale to be validated it must develop its content in strict alignment with the subject and the research objectives. Six trained specialists in the area of digital dependence constructed an initial scale with 20 questions and submitted them to an evaluation performed by six other experts. These analyzed the content for presentation, clarity, relevance and comprehension, thus providing an initial, provisional validity.

There is no consensus to define the number of specialists who should participate in the validation of a scale; therefore, this definition is at the judgment and accessibility of the researcher. However, the greater the number of specialists, the greater the disagreement, and the smaller this number (e.g. less than 3) the greater the risk of agreement being one hundred percent.

The initial version of TDDS (20 questions) was applied, as noted, to volunteers; they were asked to insert the following values next to each question: Never/Rarely (0 points); Often (1 point), Always (2 points). Marked values for each question should be added and the following results should be considered: 0 - 10 points: without disturbances; 11 – 20 points: low risk; 21 - 30 points: moderate risk; 31 - 40 points: severe risk of depression and technology dependence.

Demographic data, namely (a) age group; (b) gender; (c) Professional moment; (c) degree of education were only used for identification purposes, not for scale validation

Sample, Inclusion and Exclusion Criteria. The volunteers participating in the validation of the TDDS were patients who sought our facility with a complaint of abuse of technologies, some with major depression or other associated disorders. Inclusion was extended to students, employees, persons accompanying the patients and any who agreed to participate. Volunteers were randomly recruited through posters at the institution, verbal communication from person to person and on social networks. Participants should be aged of 16 - 65 years.

The initial TDDS (20 questions) was applied to 100 individuals divided into two groups: (a) Main group (50 participants, major depression and abusive use of technologies); (b) Control group (50 participants, no depression or abusive use of technologies).

Inclusion Criteria. In order to be included in the Main Group, participants should have scored 50 or higher on the Internet Addiction Test (IAT),[8] and to have been diagnosed with major depression, by the team psychiatrist. The Control Group included volunteers with a score lower than 50 on the IAT scale,[8] (no abusive use) and no associated mental disorders according to psychiatric evaluation .

Exclusion criteria. Illiteracy or serious mental or clinical impairment.

At the end of the data collection, we inserted the results into a database to perform statistical analyzes.

■ RESULTS

Data analysis used dplyr,[9] psy,[10] paran[11] and R[12] statistical program, version 3.4.2. The results of the descriptive statistics and of the test of hypotheses (differences of means and factor analysis) are presented below. All entries are divided into Main and Control Groups.

1) Descriptive Statistics: Table 1 shows the results of the descriptive statistics of the sample. For each characteristic we present the absolute number and the corresponding percentage.

Table 1. Sample Descriptive Statistics.

Sex					
	Male			Female	
Control	8 (16%)			42 (84%)	
Main	17 (34.7%)			32 (63.8%)	
Age ranges					
	15-25	26-36	37-. 47	48-58	59-69
Control	14 (28%)	6 (12%)	10 (20%)	7 (14%)	13 (26%)
Main	11 (22.4%)	17 (34.7%)	16 (32.7%)	4 (8.2%)	1 (2%)
Edicational level					
	Middle	higher	Graduatee	Master	Doctoral	NI
Control	16 (32%)	16 (32%)	12 (24%)	2 (4%)	3 (6%)	1 (2%)
Main	23 (46.9%)	19 (38.8%)	5 (10.2%)	2 (4.1%)	0 (0%)	0 (0%)

Average scores for the original 20-question questionnaire. The Control Group scored 3.7±4.7 points; the main group scored 19.0±6.5 points; the corresponding t-statistic was 13.42 bringing up p<0.001. This highly significant difference between groups ratified the questionnaire, separating serious dependence and depression in Main Group from no-dependence/depression in the controls.

Factor analysis. The first test performed was the Bartlett sphericity test to verify if the variables are correlated with each other. In this test, the null hypothesis is that the correlation matrix is equal to the identity matrix. For the data set, a statistic equal to 1360.107 corresponded to p<0.001, indicating that the covariance matrix was very significantly different from the identity matrix.

The Kaiser-Meyer-Olkin (KMO) criterion was used to determine the adequacy of the factor analysis. A value equal to 0.868 was found, higher than 0.8, which is considered appropriate.[13] Table 2 presents the Measure Sampling Adequacy (MAS) indices for each of the 20 variables (questions).

Due to the results found for both the Bartlett test and the KMO, we decide that it was appropriate to carry out the factorial analysis for the scale.

To check the factorial loads in order to determine the number of relevant factors, we used 3 criteria: Factorial Load, Screeplot and Parallel Analysis. Table 3 shows the Factorial Loads.

It is recommended[13] to use factor loads with cumulative values above 0.9. However, for the data set, we would have to discard 11 factors, which in practice would not solve the problem of data reduction. We then proceed to the Screeplot criterion of the correlation matrix, where we eliminate the factors related to Eigenvalues greater than 1, as shown in Figure 1.

Figure 1 shows components above the red line with variances greater than 1; these are the relevant components.

By this criterion, we may use 4 factors, and in this case, the commonalities of the variables are presented in table 4.

Analyzing these commonalities, 3 questions should be excluded because they present commonalities less than 0.5, namely questions 14, 15 and 17.

The third criterion used to find the number of factors was the Parallel Analysis where the number of factors found was equal to 2. The table with the commonalities for two factors is presented in Table 5.

With two factors, questions 7, 8, 12, 14, 15, and 17 should be eliminated because they present commonalities below 0.5. Moreover, most of the questions are left with very little of the variance explained by these factors. We

Table 2. Measure Sampling Adequacy (MAS) of Questions.

TDDS.1	TDDS.2	TDDS.3	TDDS.4	TDDS.5
0.882	0.868	0.926	0.905	0.903
TDDS.6	TDDS.7	TDDS.8	TDDS.9	TDDS.10
0.938	0.819	0.871	0.590	0.632
TDDS.11	TDDS.12	TDDS.13	TDDS.14	TDDS.15
0.910	0.781	0.859	0.706	0.869
TDDS.16	TDDS.17	TDDS.18	TDDS.19	TDDS.20
0.900	0.535	0.920	0.935	0.895

Table 3. Factorial loads of the Principal Components (PC).

|	PC1	PC2	PC3	PC4	PC5
Standard deviation	3.006	1.423	1.190	1.050	0.992
Proportion of Variance	0.452	0.101	0.071	0.055	0.049
Cummulative proportion	0.452	0.553	0.624	0.679	0.728
	PC6	**PC7**	**PC8**	**PC9**	**PC10**
Standard deviation	0.945	0.861	0.792	0.715	0.667
Proportion of Variance	0.045	0.037	0.031	0.026	0.022
Cumulative proportion	0.773	0.810	0.841	0.867	0.889
	PC11	**PC12**	**PC13**	**PC14**	**PC15**
Standard deviation	0.634	0.572	0.534	0.506	0.478
Proportion of Variance	0.020	0.016	0.014	0.013	0.011
Cumulative proportion	0.909	0.926	0.940	0.953	0.964
	PC16	**PC17**	**PC18**	**PC19**	**PC20**
Standard deviation	0.451	0.409	0.370	0.342	0.307
Proportion of Variance	0.010	0.008	0.007	0.006	0.005
Cumulative proportion	0.974	0.983	0.989	0.995	1.000
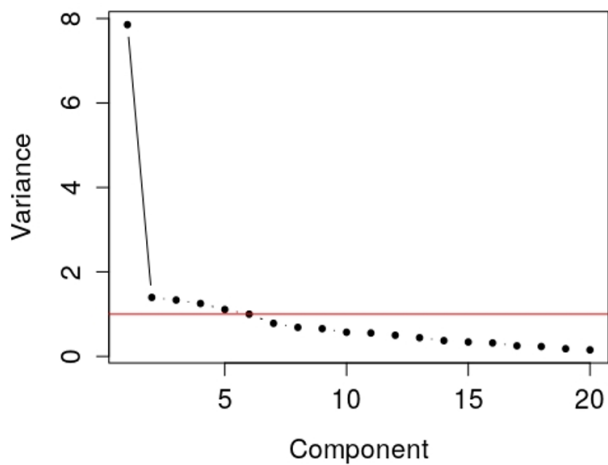
Figure 1. Screeplot chart.

therefore opted to use the results with the four factors obtained through the Screeplot Criterion.

The last step was the calculation of Cronbach's Alpha Index,[13] in order to measure the internal consistency of the questionnaire. The value found was 0.932, which is considered excellent.[13]

■ DISCUSSION

For the elaboration of a final validated scale that definitively meets the proposed objective (evaluation of depression and its relation with dependence of technologies), it would be necessary that all the stages be fulfilled and that the final adjustments be made after expert and statistical analysis. Taken jointly, the complete analysis

Table 4. Communality for 4 Factors.

TDDS.1	TDDS.2	TDDS.3	TDDS.4	TDDS.5
0.682	0.861	0.786	0.823	0.863
TDDS.6	**TDDS.7**	**TDDS.8**	**TDDS.9**	**TDDS.10**
0.743	0.594	0.668	0.763	0.708
TDDS.11	**TDDS.12**	**TDDS.13**	**TDDS.14**	**TDDS.15**
0.741	0.685	0.639	0.478	0.480
TDDS.16	**TDDS.17**	**TDDS.18**	**TDDS.19**	**TDDS.20**
0.694	0.377	0.744	0.657	0.594

Table 5. Communality with 2 Factors.

TDDS.1	TDDS.2	TDDS.3	TDDS.4	TDDS.5
0.547	0.637	0.704	0.745	0.758
TDDS.6	TDDS.7	TDDS.8	TDDS.9	TDDS.10
0.613	0.352	0.413	0.722	0.634
TDDS.11	TDDS.12	TDDS.13	TDDS.14	TDDS.15
0.653	0.487	0.560	0.204	0.401
TDDS.16	TDDS.17	TDDS.18	TDDS.19	TDDS.20
0.678	0.139	0.677	0.605	0.533

detected three questions that were considered irrelevant and which were deleted from the final version.

In a discussion of the results, starting with the results of the volunteer tests, we a highly significant difference between the means of the Principal and Control groups, which ratifies the questionnaire's adequate separation between the individuals with/without digital dependence/depression. Although not a research objective, we also recorded demographic distributions in terms of gender, age brackets and degrees of instruction, confirming the randomness of the two samples. Simply as an example, a skewed distribution across the age ranges, would have introduced a probable age-related bias.

As a pre-requisite to perform the factorial analysis, Bartlett's sphericity tests and the KMO confirmed the suitability of the factorial analysis, using three criteria; the Screeplot was the most valid, indicating the withdrawal of three items from the questionnaire. Thus the questionnaire was reduced to 17 questions. The three removed questions dealt with:

14. How often do you usually resort to computers, cell phones tablets, etc. (CCPT&O) to search for diseases or medication?

15. How often do you usually seek CCPT&O for affective/sexual relationships or to have someone to talk to?

17. How often do you usually stop taking care of your hygiene, to have more time for CCPT&O? This last issue was considered important in other studies,[14,15,16] which found an serious lack of hygiene in young people with depression and dependence on technologies.

In addition, the Cronbach Alpha Index[13] with the excellent result of 0.932 revealed the high internal consistency of this scale, reinforcing its validity within our defined objective.

The main limitation of the study was the lack of other validated specific instruments that assessed depression in relation to technology dependence. The presence of such previously reported instruments might have been useful in developing this scale

We believe that future studies on the subject may improve upon the design of instruments. The subject is very little explored and, therefore, contributions are always welcome.

■ CONCLUSION

We obtained the final validated 17-question version of the TDDS, adequate to clinical contexts and to be used in future research on the topic. All psychometric properties were checked for accuracy, reliability, presentation, clarity, relevance and comprehension of the instrument, conferring validity to the end-product.

All 17 questions of the final version of TDDS presented alignment with each other, qualifying the scale as a positive and pioneer instrument to evaluate the depression/technology dependence relation. This could meet the demand for future research that would require a specific instrument, such as this.

■ AUTHOR CONTRIBUTION:

F L Guimarães - reviewed the literature, applied the scales, worked in the database and wrote the present article.
M K Padua - applied the scales and wrote this article.
E Guedes - applied the scales and wrote this article.
L L Gonçalves - wrote this article.
H K Santos - analyzed statistically and wrote this article.
D Rodrigues - analyzed statistically and wrote this article.
A E Nardi - wrote this article.
A L S King - oriented, planned, reviewed the literature, applied the scales, worked the database, wrote this article.

■ CONFLICT OF INTEREST

All authors declare no conflict of interest.

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Annex 1. Final validates scale

Scale to evaluate depression and its relation with the dependence of technologies (computer, mobile phone, tablet, & others) in daily life (TDDS).

Date: ___ / ___ / _____ Age: _____
NAME OF VOLUNTEER: _____

Gender: F ( ) M ( )
Works: Yes ( ) No ( )
Unemployed: Yes ( ) No ( )
Level of Education: ( ) Middle ( ) High () Graduate ( ) Master ( ) Doctoral
Signature of Volunteer: _____
Email:_____
Tels ._____

INTERVIEWER: _____
This test is a scale with 17 questions that measure mild, moderate, and severe levels of depression and its relationship with dependence on technologies.
Please note: The acronym CCPT&O stands for Computer, cell phone, tablet, among other technologie.

Please enter the number corresponding to each answer next to the question:
a- Never/Rarely (0)
b- Frequently (1)
c- Always (2)

Questions

1- How often do you usually feel very sad or depressed?
2- How often do you usually feel discouraged?
3- How often do you usually feel nervous or anxious?
4- How often do you usually feel devalued or unimportant?
5- How often do you usually feel loss of interest in everyday activities?
6- How often do you look for some CCPT&O technology so you do not feel lonely or try to make friends?
7- How often do you usually cut your sleep short to stay with CCPT&O ?
8- How often do you usually feel like dying?
9- How often do you usually think about taking your life?
10- How often do you usually get CCPT&O to rule out the idea of suicide or to research the subject?
11- How often do you use CCPT&O to reduce your pessimistic or negative feelings or feelings?
12- How often do you seek to make more friends in CCPT&O than in real life?
13- How often do you usually get CCPT&O to feel included in some social context?
14- How often do you usually get the CCPT&O to search for curiosities, new subjects, to read newspapers or magazines?
15- How often do you usually get CCPT&O to change your mood from negative to positive?
16- How often do you usually stop practicing some physical activity or doing outdoor programs to stay at the CCPT&O?
17- How often do you usually get CCPT&O to find some leisure activity or company?

Results:

 Once you have answered all the questions, add up the numbers you selected for each answer to get a final score. The higher the score, the higher the level of CCPT&O dependence that may be related to depression.
Below are the points values obtained in your score:
Up to 4 points: You are a user with no signs of abuse of the CCPT&O related to depression and with full control over its use.

continued...

05 - 14 points: Mild - You show signs of possible abuse of CCPT&O related to mild depression. You begin to have occasional problems due to the onset of abusive use of CCPT&O related to depression in certain situations. This may have an impact on your personal, social, family, professional, or academic life because you are using CCPT&O more often than you need depression. Be aware that abusive use of CCPT&O does not impair your quality of life.

15 - 24 points: Moderate - You show signs of possible CCPT&O dependence related to moderate depression. You begin to have frequent problems due to the abusive use of CCPT&O related to depression in certain situations. You should consider the impacts on your personal, social, family, professional, or academic life by using CCPT&O related to depression more heavily than is recommended. You must learn to deal with CCPT&O more consciously.

25 - 34 points: Severe - The use of CCPT&O related to depression is causing significant problems in your personal, social, family, professional or academic life at a serious level. you must evaluate the consequences of these impacts that may be causing damages in these diverse areas, significantly impairing your quality of life. We recommend seeking guidance through professional help in specialized centers.