Original Article

Validity evidence of the Critical Thinking Disposition Scale, Brazilian version

Evidências de validade da versão brasileira da *Critical Thinking Disposition Scale*

Evidencias de validez de la versión brasileña de la *Critical Thinking Disposition Scale*

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Abstract

Objective: To translate, culturally adapt, analyze the validity and reliability evidence of the Critical Thinking Disposition Scale for Brazilian Portuguese.

Methods: A methodological study that involved initial translation, synthesis of translations, back-translation, assessment by a committee of experts (content validity evidence), pre-test and sending to developers for assessment. After this stage, validity evidence based on the instrument's internal structure and reliability was also performed.

Results: The final version obtained a content validity coefficient with a variation between 0.88 and 0.96 for all items. Application time varied between 11 and 20 minutes. Exploratory factor analysis indicated an internal structure formed by a single factor with adequate factor loads for all items, as well as a good item-total correlation. The instrument presented adequate evidence of reliability (Omega coefficient) equal to 0.79.

Conclusion: The instrument was translated, adapted, has content validity evidence based on the instrument's internal structure and reliability appropriate to the Brazilian culture.

Resumo

Objetivo: Realizar a tradução, adaptação cultural, análise de evidências de validade e confiabilidade da *Critical Thinking Disposition Scale* para o português do Brasil.

Métodos: Estudo metodológico que envolveu tradução inicial, síntese das traduções, retrotradução, avaliação por comitê de especialistas (evidências de validade de conteúdo), pré-teste e envio aos desenvolvedores para avaliação. Após essa etapa foi ainda realizada a avaliação de evidências de validade baseadas na estrutura interna do instrumento e de confiabilidade.

Resultados: A versão final da escala obteve coeficiente de validade de conteúdo com variação entre 0,88 e 0,96 para os itens. O tempo de aplicação variou entre 11 e 20 minutos. Análise fatorial exploratória indicou estrutura interna formada por um único fator com cargas fatoriais adequadas para todos os itens, bem como boa correlação item-total. O instrumento apresentou adequada evidência de confiabilidade (coeficiente Ômega) igual a 0,79.

Conclusão: O instrumento foi traduzido, adaptado, possui evidências de validade de conteúdo, de validade baseada na estrutura interna do instrumento e confiabilidade adequadas à cultura brasileira.

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Conflicts of interest: nothing to declare.

Resumen

Objetivo: Realizar la traducción, adaptación cultural, análisis de evidencias de validez y fiabilidad de la *Critical Thinking Disposition Scale* al portugués de Brasil.

Métodos: Estudio metodológico que incluyó traducción inicial, síntesis de las traducciones, retrotraducción, evaluación por comité de especialistas (evidencias de validez de contenido), prueba piloto y envío a los creadores para evaluación. Después de esta etapa, además fue realizada la evaluación de evidencias de validez basadas en la estructura interna del instrumento y de fiabilidad.

Resultados: La versión final de la escala obtuvo coeficiente de validez de contenido con variación entre 0,88 y 0,96 en los ítems. El tiempo de aplicación varió entre 11 y 20 minutos. El análisis factorial exploratorio indicó una estructura interna formada por un único factor con cargas factoriales adecuadas en todos los ítems, así como una buena correlación ítem-total. El instrumento presentó una evidencia de fiabilidad adecuada (coeficiente Omega) igual a 0,79.

Conclusión: El instrumento fue traducido, adaptado, posee evidencias de validez de contenido, de validez basada en la estructura interna del instrumento y fiabilidad adecuada para la cultura brasileña.

Introduction

Training professionals with the ability to think critically and make complex decisions has been the focus of curriculum guidelines for undergraduate courses in the health field.[1,2] In this field, critical thinking (CT) is understood as disposition to apply intentional reflection skills, based on scientific evidence, from higher mental processes that gather clues for solving problems.[2–4]

The scientific literature highlights that the attitude of disposition towards CT plays a fundamental role for effective CT application.[4,5] Thus, characteristics such as open mind, curiosity, honesty in facing personal prejudices, active search for truth, systematicity, perseverance are mental patterns of disposition for CT development.[2.6] These patterns can be learned through guidance and operations activities that enhance metacognition (reflect on one's own thinking).[2] It should be noted that the international consensus on CT defines it as a process of self-regulation to analyze and define what to do in a given situation. CT disposition is related to an internal motivation to perform a certain ability to engage in problem solving and decision making.[6] Therefore, CT skills will only be applied if there is a disposition to do so. Both, disposition and skills, can be mobilized by problematizing activities.[7]

Studies[7.8] have shown the positive relationship between teaching methodologies that encourage and mobilize students to develop a CT disposition and a critical immersion in the reality in which they are inserted, aiming at solving problems. Research[9] conducted with 102 medical students from Peking University, followed for six months, highlighted an improvement in the scores for CT provision with the use of problem-based learning. Another study comparatively assessed the effect of formal education (control group) and case-based learning (CBL; experimental group) on CT disposition in 80 nursing students for 18 weeks.[10] It was found that the experimental group, taught by CBL, had statistically significant scores for CT disposition, compared to the control group.

With a focus on assessment, there are few non-commercial instruments that measure CT layout in a valid and accurate manner and quickly.[3.11] Sosu[12] created the Critical Thinking Disposition Scale (CTDS), composed of 11 items, distributed in critical opening and reflective skepticism dimensions, which measure CT disposition.

Thus, considering the instrument's relevance for nursing/health teaching and absence in Brazil of an instrument that allows measuring CT disposition, this study, which aims to carry out the translation, cultural adaptation, analysis of validity and reliability evidence of CTDS for Brazilian Portuguese, is justified.

Methods

This is a methodological study conducted for cross-cultural adaptation of CTDS into Brazilian Portuguese.[13,14] Translation, cultural adaptation into Brazilian Portuguese and CTDS use were authorized by the scale's author.

The CTDS is an instrument consisting of 11 items that measure two dimensions related to CT provision: critical openness and reflective skepticism. The critical opening subscale, composed of seven items (letters a, b, c, d, e, g, h), reflects the

tendency to be attentive to new ideas, criticize assessment of these ideas and modify thinking regarding convincing evidence. The reflective skepticism subscale, which consists of four items (letters f, i, j, k), assessed tendency to learn from past experiences and to question evidence. All items are arranged on a Likert-type scale of points, and the answers vary from 1 to 5, values that correspond, respectively, to the terms "Strongly Disagree, Disagree, Disagree and Neither Disagree, Agree and Strongly Agree".

CT disposition can be classified as low, moderate, or high. To carry out classification, all 11 items must be added, finding a score ranging from 11 to 55 points.[12]

This study was developed in two phases. The first stage comprised translation and cultural adaptation, as proposed by Beaton, Bombardier, Guillemin and Ferraz.[15] The first phase consisted of six steps: initial translation, synthesis of translations, back-translation, expert committee, pre-test and sending documentation to developers to assess the adaptation process. In the second phase, validity evidence was assessed based on the instrument's internal structure and reliability.

In the initial translation stage, the instrument was translated by two professionals, independently, with mastery of English and who had Portuguese as their native language. It is noteworthy that translator 1, unlike translator 2, was aware of the concepts to be examined and had access to the article dealing with the instrument to be validated.

In the synthesis stage, the two translations into Brazilian Portuguese (T1 and T2) were compared by the two translators and one of the researchers; they, synthetically and consensually, produced the synthesis version in Portuguese (T12).

In the back-translation stage, T12 was translated back into the original language by two professionals native to the language of the original instrument and with mastery of Brazilian Portuguese, in a blind and independent manner, giving rise to the back-translations (BT1 and BT2).

Subsequently, the original version of CTDS, each translation from English to Portuguese (T1 and T2), the synthesis version (T12) and the back-translations from Brazilian Portuguese to English (BT1 and BT2) were submitted to a committee of six experts, resulting in a consensus among translations, which constituted the version used in pre-test.

A committee composed of six members was used in this study, including five experts and a certified translator (with knowledge in the process of translation and cultural adaptation and in CT). Expert assessment aimed to ensure cultural adaptation, with emphasis on semantic, idiomatic and cultural equivalence of the instrument to be used in pre-test. Then, in pre-test, the version that was agreed by all experts was applied to a convenience sample of 33 undergraduate nursing students at a public institution in Minas Gerais. In this stage, the clarity degree of all translated items and time spent to complete the instrument were verified.

To finalize the first phase (translation and cultural adaptation), it should be noted that CTDS developer ensured that all the proposed steps were followed and that the instrument achieved an acceptable translation.

In the second phase, the process of searching for internal validity and reliability evidence of the instrument translated and adapted to Brazilian Portuguese was carried out. To this end, data collection occurred with undergraduate students at the Nursing Faculty of *Universidade Federal deJuiz de Fora* (UFJF).

The sample calculation followed guidelines that suggest using a proportionality of 10 participants for each item.[16,17] CTDS[12] has a factorial structure composed of 11 items, resulting in a minimum sample of 110 students. The sample included 179 students who responded to the instrument.

Students of UFJF Nursing Graduation Course, aged 18 years and older and who were in class during the application of instruments have been included. Students who were excluded from the course due to enrollment or health reasons and those who participated in pre-test were excluded.

The database was developed in Microsoft Office Excel 2010. For statistical analyzes, programs Statistical Package for the Social Sciences (SPSS), version 22.0 and JASP, version 0.11.1 have been used.

For analysis of content validity evidence and validity evidence based on internal structure, content

validity coefficient (CVC) and exploratory factor analysis were applied, respectively. To assess data distribution, the following were adopted as indicative of non-normal data distribution: asymmetry (greater than 3), kurtosis (greater than 7), and Mardia's coefficient (greater than 5).[16,17] Then, data were analyzed searching for existence of multivariate outliers (Mahalanobis distance - D^2).[16,17]

Exploratory factor analysis was performed using the Main Axis Factorization with oblique rotation (direct oblimin) and the Kaiser criterion (minimum eigenvalue = 1) as the estimation method for factorial extraction.[18] Scree-plot was inspected and parallel analysis was used.[16,17] To identify whether data matrix could be factored, Kaiser-Meyer-Olkin (KMO) and Bartlett sphericity tests were used. KMO was considered adequate if greater than 0.80 and Bartlett's sphericity test $p < 0.05$.[16,17]

The factor load matrix was analyzed to identify items and their correspondence with factors. A cut-off point of 0.40 was considered adequate for item retention.[19] Items with a factor load (λ) greater than 0.32 were considered cross loads.[19] Finally, item-total correlation was analyzed.[16,17]

The reliability estimate of the internal structure was obtained using the Omega coefficient (95% CI).[20] Values above 0.70 were considered adequate.[20]

All stages of the investigation were carried out in accordance with Resolution 466/2012 of the Brazilian National Health Council (*Conselho Nacional de Saúde*) for research involving human beings. This project was approved by the Research Ethics Committee (opinion 2.404.971, CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 77669417.0.0000.5147), and participants were informed about the study and signed the Informed Consent Form.

Results

The first three steps, related to translation, synthesis and back-translation, were carried out satisfactorily, with the need for minor changes. All suggestions made were widely discussed until the adapted version was obtained.

In the fourth stage, which concerns review by a committee, six experts participated, whose age varied between 30 and 53 years, with an average of 41.5 years. Of these, four (66.7%) were female and self-declared to be white, half (three) lived in São Paulo State and the other half in Minas Gerais State. With regard to education, all were graduated in nursing, three were PhD, two were masters and one specializes in field. Concerning experience, half (three) of the expert committee had knowledge on CT, two on the method of translation, cultural adaptation, and validation, and one was aware of both the subject and the method.

Still at this stage, a synthesis of the two translations (T12) was assessed by a committee of experts in terms of cross-cultural equivalence requirements of each item. To this end, they considered all versions (T1, T2, BT1 and BT2) and all reports from them. In stages I, II, III and IV, when there was disagreement in relation to a term or expression, the most usual in Brazilian Portuguese was chosen, ensuring maintenance of semantic, idiomatic, experiential and conceptual equivalences in all items.

After this assessment, all judges deemed it necessary to make changes to item "g" and the title. For instance, translator 1 translated the expression "biggerpicture" to "*como um todo*" and translator 2 "*no context geral*". As it is a figure of speech, together with the two translators, the experts decided to adopt the expression "*no context geral*". Regarding the original title in English, "Critical Thinking Disposition Scale", the main repercussion fell on the term "disposition". Although both translators chose the term "*disposição*", it was initially understood that the closest term was "*atitude*". However, after performing back-translation assessment and assessment by the scale's author, the term "*disposição*" was chosen, considering that the term "*atitude*" is not compatible idiomatically in the original language of the instrument.

In the next stage, called pre-test, the pre-final version (agreed by experts) was applied, at random, and analyzed by 33 students in a pilot test. The participants' ages varied between 22 and 38 years,

with an average of 27.9 years. Most (81.8%) were female and self-declared to be white (60.6%). The instrument's application time varied between 11 and 20 minutes. We opted for individual or self-administered application, although it can be applied collectively.

Concerning the degree of clarity of the translated items, 90% (n = 30) of students considered the instrument's title clear or very clear, 87% (n = 29) considered the outline clear or very clear, and 84.5% (n = 28) assessed the Likert-type scale items as clear or quite clear. However, one student (3%) considered item "h" as "unclear". It was decided not to modify it, since the doubt was related to the expression "*convicções mais fortes*". This is an important statement for the critical opening subscale, and no other suitable expression has been found for substitution.

Thus, after adjusting all considerations made by students, the authors chose to return to step IV and ask the judges to reassess the instrument's degree of clarity. This time, the degree of agreement among judges ranged from 0.88 to 0.96 for all items, and the scale's general CVC was 0.91, as can be seen in Table 1.

Table 1. Content validity evidence per item (Brazilian Portuguese version)

Item	CVC item
a. *Eu frequentemente estou à procura de novas ideias*	0.88
b. *Eu frequentemente uso novas ideias para definir (ou modificar) a maneira como faço as coisas*	0.92
c. *Eu utilizo mais do que uma fonte para encontrar informações*	0.96
d. *É importante justificar as escolhas que eu faço*	0.92
e. *É importante compreender o ponto de vista de outras pessoas com relação a um determinado assunto*	0.92
f. *Eu normalmente penso sobre as várias consequências de uma decisão antes de agir*	0.92
g. *Eu, durante uma discussão, normalmente tento pensar no contexto geral*	0.88
h. *Às vezes, eu encontro um bom argumento que contesta algumas das minhas convicções mais fortes*	0.88
i. *Eu normalmente verifico a credibilidade das fontes de informação antes de fazer julgamentos*	0.96
j. *Eu frequentemente reavalio minhas experiências para que eu possa aprender com elas*	0.88
k. *Eu frequentemente penso sobre minhas ações para ver se eu posso melhorá-las*	0.88
Overall CVC	0.91

CVC - content validity coefficient

In the second phase of the validation process, validity evidence based on the instrument's internal structure and reliability was carried out.

Of the 179 undergraduate nursing students who answered the test, 50.3% were in the first cycle degree program and 49.7% in the second cycle degree program; the mean age was 22.3 years (SD: 5.7). Most (84.9%) of participants were female, 57% self-declared white and 74.3% had a family income of up to five minimum wages.

Analysis of data distribution did not indicate high values of asymmetry and kurtosis. Likewise, Mardia's coefficient was less than 5. Together, these indicate data normality. The presence of outliers multivariate was not identified.

Bartlett's sphericity test was significant (χ^2 (55) = 416.671, p <0.0001), and KMO measure was 0.81. Factorial solution indicated the presence of two factors that together explain 44.88% of the total data variance (Table 2). The eigenvalues observed for factors 1 and 2 are adequate, corresponding to 3.585 and 1.352, respectively. The internal structure identified differs from that originally proposed by Sosu.[12] The suggested factorial solution is difficult to interpret, since items that originally formed the "critical openness" factor carried the "reflective skepticism" factor, and vice versa. Additionally, a borderline factor load was observed for two items (letters "d" and "h"), as well as the presence of a cross load for factors 1 and 2 for two items (letters "h" and "i"). This reinforces the fact that the two-factor structure identified is not adequate and suggests that another internal structure could be more adjusted to assess CT disposition. In fact, parallel analysis disputes the existence of two factors (Figure 1). The eigenvalue obtained for factor 2 by parallel analysis is higher than that obtained by data factor analysis.

Thus, exploratory factor analysis was again conducted, fixing the solution in a single factor (Table 2). The factorial load of all items was higher than the 0.40 cut-off point. The lowest factor load identified (λ = 0.49) was for item "d". The item-total correlation was adequate for all items. Finally, the instrument presented an overall scale Omega coefficient equal to 0.79 (95% CI = 0.74 - 0.83). Such indicators suggest that a single factor structure formed by 11 items is capable of representing CT disposition.

Table 2. Eigenvalues, variance explained by factor, item-total correlation, and extraction of factors from CTDS

Items	Eigenvalues	Variance explained by factor (%)	Correlation item-total	Factorial solution initial (λ)		Factorial solution final (λ)
				Factor 1	Factor 2	
a	3.585	32.59	0.39	0.01	0.79	0.51
b	1.352	12.29	0.47	0.23	0.65	0.59
c	0.987	8.98	0.40	0.08	0.71	0.52
d	0.903	8.21	0.38	0.40	0.28	0.49
e	0.846	7.70	0.39	0.56	0.12	0.50
f	0.768	6.98	0.43	0.76	-0.04	0.56
g	0.669	6.08	0.52	0.72	0.14	0.64
h	0.552	5.02	0.39	0.33	0.40	0.50
i	0.490	4.45	0.50	0.33	0.59	0.63
j	0.460	4.18	0.51	0.64	0.24	0.65
k	0.388	3.52	0.52	0.63	0.28	0.66

CTDS - Critical Thinking Disposition Scale; % - percentage of variance explained by factor; λ - factorial load; Extraction method by Main Axis Factorization (oblique rotation, direct oblimin); Factor loads in bold represent the item's relevance in its factor

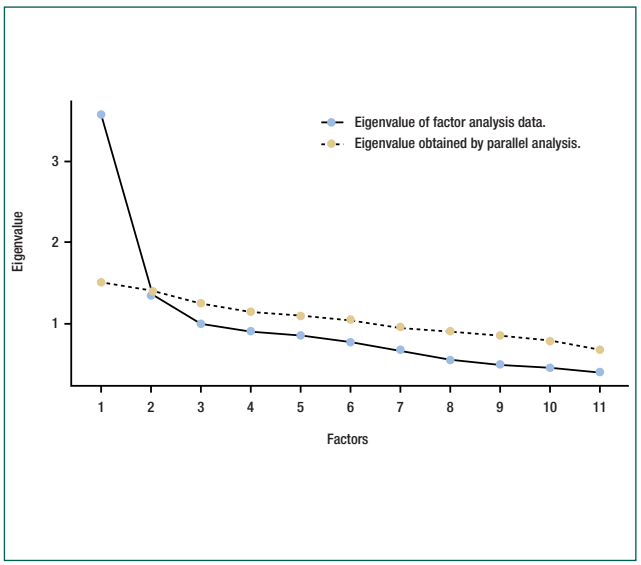

Figure 1. Scree-plot indicative of the numbers of factors obtained by exploratory factor analysis (eigenvalues greater than 1) and by parallel analysis

Discussion

Studies[3,11] on CT have been expanding in Brazil; however, there are still few that are based on tools capable of assessing/measuring this competence in a valid and reliable way. Internationally, only the Cornell Critical Thinking Test (CCTT), the California Critical Thinking Disposition Inventory (CCTDI) and the CTDS measure CT disposition, but none of these instruments had their validity evidence assessed for Brazilian Portuguese. [3,7,11]

CTDS[12] is an instrument that has validity evidence and reliability, as well as CCTT and CCTDI; however, it stands out for being an objective instrument, easy to apply and not commercial. Furthermore, based on reliability and validity standards, the translation and cultural adaptation processes proved to be satisfactory.[13-15]

Back-translation into English, performed by two translators independently, pointed out that the version translated and adapted for Brazil maintained correspondence with the version of the original instrument. The final result of translation and adaptation made it possible to adapt translated terms, respecting all equivalences and degree of agreement in all items greater than 80%.[14]

To date, no studies have been identified in the scientific literature that have carried out translation and cultural adaptation of CTDS in order to enable a comparison in this regard. It is noteworthy that the rigor in the process of translation and validation of a measurement instrument has been strongly recommended, as it produces validity evidence in another cultural context.[13-15]

Validity evidence was obtained based on the instrument's internal structure. In a first data exploration, a structure formed by two factors was obtained. However, analysis and parallel analysis of the interpretation of all items and factors indicated inadequacy of this structure.[16,17] The exploratory factor analysis was renewed and indicated that the Brazilian version of CTDS is better adjusted with a single factor that represents CT disposition. The 11 original items on the scale had a satisfactory factor load for their retention as well as an adequate item-total correlation. It is noteworthy that this internal structure differs from that obtained in the original CTDS validation study,[12] which indicates the need for confirmatory studies of this structure for Brazil. In other words, it is necessary to assess whether CT disposition represented by dimensions such as "critical openness" and "reflective skepticism", as proposed by Sosu[12] in CTDS validation, or if the construct can be described in a one-dimensional way. Both a two-factor structure and a one-dimensional structure of CTDS were assessed, and

the latter was the best fit. Further studies should assess competing models in order to contribute to the theoretical foundation on CT disposition as well as to confirm the data indicated here in other cultural realities.

Concerning analysis of evidence of CTDS reliability, CTDS had an Omega coefficient greater than 0.70 (ώ = 0.79; 95% CI = 0.74 - 0.83). In the original version of CTDS, the results of internal consistency were obtained using Cronbach's alpha coefficient, with a value of 0.79.[12] A research carried out in Turkey, with a sample of 212 undergraduate students, found Cronbach's alpha coefficient of 0.78.[21] Based on these results, we can see that our values are similar to those obtained for the overall scale in previous CTDS validation studies.[12,21] We emphasize that, given the nature of a Likert-type scale for answering CTDS, we used the coefficient Omega, which is most suitable for this type of analysis.[20]

Thus, through analyzes of the search for validity evidence based on the instrument's internal structure and reliability, it is ensured that CTDS, Brazilian version, can be applied in activities in which one wants to assess CT disposition. It is an important tool for research with academics and professionals, including nursing/health.

A small number of participants stands out as a limitation for this research. Despite following recommendations on the minimum number of participants per items of the instrument, it is considered that samples above 300 individuals are more appropriate to assess the reliability and quality of factor analysis.[16,17] Furthermore, the sample is composed of students from a specific context, which is known to affect the fit of the model.[16]

Conclusion

Translation and cultural adaptation of CTDS allowed its adaptation to Brazil. CTDS showed content validity evidence as well as validity evidence based on the instrument's internal structure and an adequate reliability estimate. The instrument, adapted to Brazilian culture, may be useful to assess academic and professional activities regarding CT disposition.

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Collaborations

Luiz FS, Leite ICG, Carvalho PHB, Püschel VAA, Braga LM, Dutra HS, Sanhudo NF and Carbogim FC contributed to study design, data analysis and interpretation, writing of the article, relevant critical review of intellectual content and approval of the final version to be published.

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