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Adult Concentration Inventory (ACI) Brazilian Portuguese version: cross-cultural adaptation and validation study

Adult Concentration Inventory (ACI) versão em português do Brasil: adaptação transcultural e estudo de validação

Adult Concentration Inventory (ACI) versión en portugués brasileño: estudio de adaptación y validación transcultural

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ABSTRACT:
Introduction: Sluggish Cognitive Tempo (SCT) designates a group of symptoms related to impairments in valuable life domains. **Objectives:** The aims were to translate, adapt and validate a psychometrically informed scale of SCT, the Adult Concentration Inventory (ACI), for the Brazilian context. **Method:** The scale was translated, back-translated, and evaluated by an expert panel. After the semantic equivalence analysis, 446 participants (295 women) aged 18 to 65 years (M = 34.99, SD = 10.7) answered an internet-based survey. An Exploratory Factor Analysis (EFA) was conducted with the items of the ACI, Adult Self Report Scale (ASRS-18), the Self-Report Questionnaire (SRQ-20) to evaluate the convergent and discriminant validity of ACI items. A Confirmatory Factor Analysis (CFA) was performed to test the ACI latent structure. Correlations between ACI, ASRS-18 and SRQ-20 were also calculated. **Results:** The experts' semantic equivalence analyzes pointed to 85% of average agreement. The EFA with ACI, ASRS-18, and SRQ-20 showed 10 ACI items with acceptable convergent and discriminant validity. The most suitable solution in the CFA was the one-factor model (RMSEA = 0.039 [IC90%: 0.0 – 0.09]; CFI =

0.997; TLI = 0.996). The reliability was satisfactory (α = 0.920). The correlations between ACI measures and the ASRS-18 inattention were high. Conversely, the correlations with the ASRS-18 hyperactivity-impulsivity were of medium intensity and when controlling for inattention became non-significative. **Conclusion:** Overall, the preliminary results showed the reliability and validity of the ACI Brazilian Portuguese version. Further studies should focus on determining the generalization and measurement invariance of these findings.

Keywords: sluggish cognitive tempo, attention deficit-hyperactivity disorder, adult, self-report, psychometrics.

RESUMO:
Introdução: O Sluggish Cognitive Tempo (SCT) designa um grupo de sintomas relacionados com deficiências em domínios valiosos da vida. **Objetivos:** Os objetivos foram traduzir, adaptar e validar uma escala psicometricamente informada de SCT, o Adult Concentration Inventory (ACI), para o contexto brasileiro. **Método:** A escala foi traduzida, retrotraduzida e avaliada por um painel de especialistas. Após a análise de equivalência semântica, 446 participantes (295 mulheres) com idades entre 18 e 65 anos (M = 34,99, DP = 10,7) responderam a uma pesquisa na Internet. Foi realizada uma Análise Fatorial Exploratória (EFA) com os itens do ACI, Adult Self Report Scale (ASRS-18), o Self-Report Questionnaire (SRQ-20) para avaliar a validade convergente e discriminante dos itens do ACI. Uma Análise Fatorial Confirmatória (CFA) foi realizada para testar a estrutura latente do ACI. Correlações entre ACI, ASRS-18 e SRQ-20 também foram calculadas. **Resultados:** As análises de equivalência semântica dos especialistas apontaram 85% de concordância média. A EFA com ACI, ASRS-18 e SRQ-20 apresentou 10 itens ACI com validade convergente e discriminante aceitável. A solução mais adequada no CFA foi o modelo de um fator (RMSEA = 0,039 [IC90%: 0,0 – 0,09]; CFI = 0,997; TLI = 0,996). A confiabilidade foi satisfatória (α = 0,920). As correlações entre as medidas do ACI e a desatenção do ASRS-18 foram altas. Por outro lado, as correlações com a hiperatividade-impulsividade do ASRS-18 foram de média intensidade e quando controladas por desatenção tornaram-se não significativas. **Conclusão:** No geral, os resultados preliminares mostraram a confiabilidade e validade da versão em português do Brasil do ACI. Novos estudos devem se concentrar em determinar a generalização e a invariância de medição desses achados.

Palavras-chave: ritmo cognitivo lento, transtorno de déficit de atenção e hiperatividade, adulto, autorrelato, psicometria.

RESUMEN:
Introducción: Sluggish Cognitive Tempo (SCT) designa un grupo de síntomas relacionados con deficiencias en dominios valiosos de la vida. **Objetivos:** Los objetivos fueron traducir, adaptar y validar una escala informada psicométricamente de SCT, el Inventario de Concentración de Adultos (ACI), para el contexto brasileño. **Método:** La escala fue traducida, retrotraducida y evaluada por un panel de expertos. Después del análisis de equivalencia semántica, 446 participantes (295 mujeres) de 18 a 65 años (M = 34,99, SD = 10,7) respondieron una encuesta basada en Internet. Se realizó un Análisis Factorial Exploratorio (AFE) con los ítems del ACI, la Escala de Autoinforme de Adultos (ASRS-18), el Cuestionario de Autoinforme (SRQ-20) para evaluar la validez convergente y discriminante de los ítems del ACI. Se realizó un análisis factorial confirmatorio (CFA) para probar la estructura latente de ACI. También se calcularon las correlaciones entre ACI, ASRS-18 y SRQ-20. **Resultados:** Los análisis de equivalencia semántica de los expertos señalaron un 85% de acuerdo promedio. El EFA con ACI, ASRS-18 y SRQ-20 mostró 10 ítems ACI con validez convergente y discriminante aceptable. La solución más adecuada en el AFC fue el modelo de un factor (RMSEA = 0,039 [IC90%: 0,0 – 0,09]; CFI = 0,997; TLI = 0,996). La confiabilidad fue satisfactoria (α = 0.920). Las correlaciones entre las medidas de ACI y la falta de atención de ASRS-18 fueron altas. Por el contrario, las correlaciones con la ASRS-18 hiperactividad-impulsividad fueron de intensidad media y cuando se controló por desatención se volvieron no significativas. **Conclusión:** En general, los resultados preliminares mostraron la confiabilidad y validez de la versión en portugués brasileño del ACI. Los estudios adicionales deben centrarse en determinar la generalización y la invariancia de medición de estos hallazgos.

Palabras clave: ritmo cognitivo lento, desorden hiperactivo y deficit de atencion, adulto, autoinforme, psicometria.

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Introduction

Sluggish cognitive tempo (SCT) is a collection of symptoms related to daydreaming, slowed moving, drowsiness, mental confusion, apathy, and feeling spacey. This cluster has been explored majorly within the background of attention deficit-hyperactivity disorder (ADHD).

There was early evidence pointing to a strong relationship between SCT and inattention symptoms [1]. In a meta-analytic review, the authors analyzed 19,000 individuals from 23 independent samples. They performed factorial analyses, founding a separate factor for SCT concerning ADHD [1]. The authors highlighted the fact of the researches about SCT are just beginning, despite the growth of publications in the last decades. There is no strong support to understand SCT than a "pure inattentive" form of ADHD. At the same time, there is insufficient data to draw a conclusion about a separate disorder [1].

A more parsimonious hypothesis is the transdiagnostic implication of SCT. For example, Ekinci et al. [2] verified that higher symptoms of SCT were associated with autism spectrum disorder (ASD) and multiple anxiety disorders in children with ADHD. Brewe et al. [3] investigated the incidence of SCT in a small sample comprised of young adults with ASD. Almost a third showed significant SCT symptoms which were associated with more executive functioning problems and higher levels of depression. In a similar direction, Mayes et al. [4] performed a study with motes' ratings of 1,436 children with autism, 1,056 with ADHD without ASD, and 186 controls.

Fifty-nine percent of the ASD sample had at least 1.5 standard deviations higher in the SCT scale compared to 40% with ADHD inattentive and 30% with ADHD combined presentation. In sum, there is no consensus about the specific nosology of SCT, despite the advance in the characterization of the phenomena.

In terms of association with other behavioral problems, internalizing symptoms are strongly correlated to SCT meanwhile there is a weak correlation with externalizing spectrum disorders [5].

Social withdrawal is one of the most important impairments associated with SCT as well as loneliness and suicide risk [6]. Fredrick et al. [7] demonstrated an association between mind-wandering, rumination, and SCT symptoms beyond ADHD symptomatology.

Becker et al. [5] presented the connection between SCT and sleep problems in children. Flannery et al. [8] reported an association between SCT and crucial outcomes in a college sample after controlling symptoms of ADHD, anxiety, and depression. Higher SCT levels pleaded to poorer study skills, more executive functions impairments in daily life, and greater difficulties in domains of life such as education, work, finances, and household tasks.

ADHD inattentive (ADHD-IN) presentation did not associate with those impairments when SCT symptoms entered the model. In summary, the functional impairments related to SCT seem to be independent of the association with ADHD symptoms. This assumption leads to an important implication for future researches.

In adults, SCT seemed to contribute to a wider level of heterogeneity of ADHD. Kamradt et al. [9] found that adults with higher SCT symptoms exhibited more depressive, anxious, -persistent inattentive symptoms, and more impairments in professional and social domains.

Barkley [10] examined a nationally representative sample of adults from the U. S and found that 6.8% of the sample exhibited higher levels of ADHD in contrast to 5.8% with more intense SCT symptoms. 54% of those with higher levels of SCT met the criteria for ADHD. The ADHD group was considerably younger than the SCT group. The groups with more SCT symptoms had more impairments in Self-Organization/Problem Solving subscale.

The SCT-only group had more problems in the work domain compared to the others. Becker et al. [11] described a similar pattern of difficulties. Individuals with higher levels of SCT symptoms showed more difficulties in Self-Organization/Problem Solving and Self-Management to Time than the ADHD inattentive group.

The biological underpinnings of SCT are much less clear compared to the findings of ADHD research. Bolat et al. [12] performed a study to investigate the genetic influence in the SCT presentation. They described that the group with ADHD symptoms without SCT had more 4R homozygosity for the DRD4 gene meanwhile the group with SCT without ADHD symptoms exhibited a higher proportion of the 7R allele. In addition, they found no significant difference between those groups in the neuropsychological measures.

Firat et al. [13] reported that daydreaming in pretreatment predicts more inattention as well as more overall ADHD symptoms at school after one month of methylphenidate therapy. McBurnett et al. [14] suggested the efficacy of atomoxetine to treat SCT.

To investigate the psychometric properties of the SCT scales, Becker [15] performed a systematic review. The author found 9 instruments, six stand-alone SCT questionnaires, and three inserted in broader ADHD measures. Only two scales are targeted to adults. All included SCT contents of daydreaming and drowsiness, despite the divergence among other psychopathological features. Regarding the factorial structure, six scales presented a unidimensional model, and the others vary from 2 to 3-factor solutions. Some studies tested a bifactor model. The internal consistencies are acceptable (all > 0.7). The measures of SCT showed a satisfactory test-retest reliability across weeks to one year. These results suggested that SCT scales have encouraging psychometric properties.

One of those measures was the Adult Concentration Inventory–ACI [1]. The authors made a meta-analysis to define the best items that assess SCT symptoms in adults. Based on these findings, the ACI was created. To evaluate the validity and reliability of ACI, they conducted a study with 3,172 college students from U. S [11].

Ten items demonstrated convergente and discriminant validity from internalizing symptoms and ADHD inattentive dimension. Six items were added to capture other SCT features, totalizing 16 items.

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The aims of this study were 1) To investigate the content and construct validity of the ACI for the Brazilian context. 2) To test the dimensionality and reliability of ACI. 3) To examine convergent and divergent validity of ACI from ADHD-IN and internalizing symptoms.

Methods

Translation procedures

The translation and cross-cultural adaptation followed the guidelines of the International Test Commission [16] and the International Society for Pharmacoeconomics and Outcomes Research–ISPOR [17].

First, two researchers independently translated the scale into Brazilian Portuguese. A third researcher compared these versions and conciliate them. An English professor with a bachelor's degree in Arts back-translated the first synthesis version. The researchers sent it to the original author of ACI who analyzes the semantic correspondence.

All considerations were pondered to assure the construct representability. After the modifications' appreciation, ten bilingual Brazilian experts in Psychology evaluated potential linguistic differences and imprecisions. All of them had at least a master's degree and a fluent English level.

They scrutinized the equivalence between the Brazilian Portuguese and English versions with three options of answer: equivalent, partially equivalent, and not equivalent. The authors evaluated the results and calculated an index to represent the overall equivalence. Qualitative information was also considered. To analyze the dimensionality and other psychometric properties of the Brazilian ACI version, a broader survey was performed

Sample

The participants were recruited through advertisements in the researcher's social media and word of mouth. The broad survey using the ACI had the approval of the Ethics Committee of the Federal University of Minas Gerais under the number: 07570312.9.0000.5149. The eligibility criteria were age (from 18 to 65 years old) and the understanding of the statements and instructions. All participants had to accept the free and informed consent term before starting the survey.

Measures

Adult Concentration Inventory (ACI)

The self-report scale includes 16 items of SCT symptoms: 13 previously identified in a meta-analysis [1] and 3 added to assess mental confusion features. The items are based on a four Likert scale ranging from 0 to 3 (0 = not at all, 1 = sometimes, 2 = often, 3 = very often) considering the past six months. There is another part that measures impairments in daily functioning related to SCT symptoms. In this part, the answers were rated on a five-point scale (from 0 = no difficulty to 4 = severe difficulty). Becker et al. [11] did not include this set of items in their statistical analyses. Only 10 items demonstrated both convergent and discriminant validity from ADHD-IN and internalizing symptoms. The Cronbach's Alpha for the 10 items version was 0.89.

Adult Self-Report Scale (ASRS-18)

The scale measures ADHD symptoms according to the a criterion of the Diagnostic and Statistical Manual for Mental Disorders [18]. The scale has 18 items, the first 9 are related to inattention (ADHD-IN), and the others comprised hyperactivity/impulsivity (ADHD-H/I) dimension [19]. The ASRS-18 is rated on a five-point Likert scale (0 = never, 1 = rarely, 2 = sometimes, 3 = often, 4 = very often). The original version had a Cronbach's α of 0.88. Mattos et al. [20] translated and adapted ASRS-18 into Brazilian Portuguese.

Self-Report Scale (SRQ-20)

The SRQ is a screening measure with 20 yes-no questions that assess frequent complaints related to anxiety, depression, and psychosomatic disorders [21]. The first Brazilian Portuguese version was published by Mari and Williams [22]. In a study with 1,688 women from multiple Brazilian locations, Paraventi et al. [23] tested different latent structures for the SRQ-20. The most suitable model was a three-factor solution: anxiety/depression, disability, and somatic symptoms. The reliabilities were calculated in the present study as a result of an absence of this information.

Data analysis

The means of the expert panel answers were calculated to compare the semantic equivalence. This procedure is similar to the Content Validity Index (ICV). Correlations between the 16 items of SCT symptoms and among the suggested total scores were performed.

Following earlier studies about SCT scales, an Exploratory Factor Analysis (EFA) was conducted to evaluate the convergent and discriminant validity of ACI in comparison to ADHD-IN and internalizing symptoms.

For this purpose, the sample was randomly divided into two subsamples (A and B). SCT items were expected to show high loadings on the SCT factor (at least 0.6 in one sample and 0.5 in the other) and low loadings on the ADHD-IN and Anxiety/Depression factors (less than 0.3 in both samples).

In convergence, the ADHD-IN and Anxiety/Depression were expected to have high loadings into their factors and low loadings on the SCT factor. Only the items that demonstrated convergent and discriminant validity from ADHD-IN and Anxiety/Depression were retained to perform EFA and CFA. A one-factor SCT solution was tested to replicate the previous study of ACI. Finally, correlations among SCT, ADHD-IN, and internalizing symptoms were calculated.

Subsamples A and B were used to cross-validate the convergent and discriminant validity. Subsample A was employed to perform the EFA of the Brazilian ACI version. Subsample B was hired for the CFA of ACI. Other analyses were performed with the complete sample.

Pearson correlations were calculated with the bootstrapping procedure (a thousand simulations). The reliability was evaluated by the Cronbach's Alpha (α), McDonald's Coefficient (ω), and the Composite Reliability index (CR). The Cronbach's Alpha may be greater than 0.7 to indicates an acceptable internal consistency [24]. The CR was obtained using the calculator of Colwell [25].

The open-source software Factor V.10.10.03 executed the Exploratory Factor Analysis [26]. The extraction method Robust Diagonally Weighted Least Squares (RDWLS) resulted in a polychoric correlation matrix [27]. To determine the retained factors' number, Parallel Analysis (PA) with the Robust Promin rotation was used. The Kaiser retention method was also calculated (Eigenvalues > 1).

To estimate the data's potential to the EFA, the Kaiser-Meyer-Olkin (KMO) indicator and Bartlett's Test of Sphericity were assessed. Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR) or the Root Mean Square of Residuals (RMSR), χ^2, χ^2/df,

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Comparative Fit Index (CFI), Non-Normal Fit Index (NNFI which is equivalent to the Tucker Lewis Index - TLI) were calculated to assess the model's goodness-of-fit.

The R software [28] with the lavaan package [29] executed the CFA. The estimation method was the Weighted Least Squares Mean and Variance (WLSMV) with the Satorra-Bentler correction. Model fit estimators were the Chi-Squared test, χ^2/df ratio, CFI, TLI, RMSEA, and SRMR. Also, the McDonald's Coefficient (ω) was calculated in R.

KMO values higher than 0.7 and Bartlett's Test of Sphericity with $p < 0.05$ are acceptable parameters as specified by Watkins [30]. According to Schreiber et al. [31], the cutoffs for absolute fit indices were: SRMR below 0.08; RMSEA under 0.06, and Chi-Squared test with $p > 0.05$. The chi-square/df ratio should be less than 3. Concerning the comparative fit indices, the suggested cutoffs were: close to or above 0.95 for CFI, NNFI, and TLI [32].

Results

Sociodemographic data

The study included 446 participants (295 women; 66.1%) ranging from 18 to 63 years old (M = 34,99 years, SD = 10.7). Most of them were from the Southwest region of Brazil (71.74%). The majority was single (53.4%), with a college degree (30.3%) and medium to high socioeconomic level (33.9%). In relation to previous mental health diagnoses, 51.8% of the participants denied any mental health diagnosis. The three most reported diagnoses were: ADHD (22.9%), Depressive Disorders (20.4%), and General Anxiety Disorder (15.2%).

Semantic equivalence

The overall correspondence between the original scale and the ACI-translated version was 85%. 14.2% of the items had a partial equivalence and only 0.8% exhibited no semantic correspondence as showed in Table 1. For the 10-items version, the correspondence rate was 82%. The partial equivalence showed 16% of agreement and 2% reached no semantic equivalence. Three items (2, 4, 12) demonstrated a semantic equivalence rate lower than 0.8.

Item-total score correlations

As showed in Table 1, all items had statistical significative correlations with the estimated total scores ($p < 0.01$). The magnitudes were medium to

strong. Only the correlation between item 21 and the full ACI version total score exhibited a relatively weak result (r = 0.369).

Inter-item correlations

As summarized in Table 2, the correlations among the 16 items concerning the SCT symptoms were all statistically significant ($p < 0.01$) and varied from 0.378 to 0.758.

Convergent and Discriminant Validity of SCT, ADHD-IN and Internalizing symptoms

For the subsample A, the Bartlett's sphericity test was significant (χ^2 (496) = 2423.5; $p < 0.001$) and the Kaiser-Meyer-Olkin (KMO) was 0.965. These results indicated the suitability of the matrix to perform an EFA. The parallel analysis indicated a two-factor solution with 62.07% of explained variance meanwhile the Kaiser criteria pointed to a three-factor solution. The goodness-of-fit indexes were adequate (χ^2 = - 312.175, df = 403, $p > 0.001$; χ^2/df = - 0.774; RMSEA = 0.00; RMSR = 0.535; CFI = 1.075; NNFI = 1.093).

For the subsample B, the KMO was 0.959 and the Bartlett's sphericity test was significant (χ^2 (496) = 2423.5; $p < 0.001$). Also, the parallel analysis suggested a two-factor solution (60.44% of explained variance) and the Kaiser criteria pointed to a three-factor solution. The goodness-of-fit indexes were satisfactory (χ^2 = -85.59, df = 403, $p > 0.001$; χ^2/df = - 0.212; RMSEA = 0.00; RMSR = 0.0504; CFI = 1.043; NNFI = 1.053).

As summarized in Table 3, only 10 items (1, 2, 3, 4, 5, 6, 8, 10, 14, and 16) reached both criteria for convergent and discriminant validity about ADHD-IN and anxiety/depression symptoms across the subsamples A and B.

Exploratory and Confirmatory Factor Analyses for the SCT one-factor model

Kaiser-Meyer-Olkin (KMO) was 0.88 and the Bartlett's sphericity test was significant (χ^2 (45) = 1678.1; $p < 0.001$), demonstrating the suitability of the data to perform an EFA. A two-factor solution was indicated by the parallel analysis (69.07% of explained variance). However, the Kaiser criteria pointed to a one-factor solution as detailed in Figure 1. The goodness-of-fit measures were: χ^2 = 123.22, df = 35, $p < 0.001$; χ^2/df = 3.5; RMSEA = 0.107; RMSR = 0.0722; CFI = 0.984; NNFI = 0.979). The RMSEA, RMSR and χ^2 /df were higher than the recommended standards. However, the CFA fit indices were suitable (χ^2 = 46.864, df = 35, p >

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0.001; χ^2/df = 1.33; RMSEA = 0.039 (IC90%: 0.0 – 0.09); RMSR = 0.06; CFI = 0.997; TLI = 0.996). The ACI items showed loadings ranging from 0.663 to 0.866 on the SCT factor (Mloadings = 0.76, SDloadings = 0.060). Table 4.

Exploratory and Confirmatory Factor Analyses for the SCT one-factor model

Kaiser-Meyer-Olkin (KMO) was 0.88 and the Bartlett's sphericity test was significant (χ^2 (45) = 1678.1; p < 0.001), demonstrating the suitability of the data to perform an EFA. A two-factor solution was indicated by the parallel analysis (69.07% of explained variance). However, the Kaiser criteria pointed to a one-factor solution. The goodness-of-fit measures were: χ^2 = 123.22, df = 35, p < 0.001; χ^2/df = 3.5; RMSEA = 0.107; RMSR = 0.0722; CFI = 0.984; NNFI = 0.979). The RMSEA, RMSR and χ^2 /df were higher than the recommended standards. However, the CFA fit indices were suitable (χ^2 = 46.864, df = 35, p > 0.001; χ^2/df = 1.33; RMSEA = 0.039 (IC90%: 0.0 – 0.09); RMSR = 0.06; CFI = 0.997; TLI = 0.996). The ACI items showed loadings ranging from 0.663 to 0.866 on the SCT factor (Mloadings = 0.76, SDloadings = 0.060). Table 4.

Reliability

The results indicated a satisfactory reliability of the 10-item ACI solution: (ω = 0.94; α = 0.92 and CR = 0.932). Table 5 presented the Cronbach's Alpha for the other scales. For the ACI full version (24 items) the α was 0.95 and for the 16-item version, the α was 0.947.

Correlations between ACI, SRQ-20 and ASRS-18

All were statistically significant (p < 0.001) as summarized in Table 5. The results between the ACI measures and ASRS-IN varied from 0.726 to 0.805. Specifically, the correlation between the full ACI total score and the ASRS-IN reached 0.805, the higher value among all found coefficients. The associations between ACI measures and ASRS-H/I was in medium intensity (from 0.428 to 0.541). SRQ-20 Somatic factor showed medium size coefficients with all ACI dimensions (0.524 > r > 0.509) meanwhile SRQ-20 Disability factor exhibited higher associations (0.78 > r > 0.652). The SRQ-20 Anxiety/Depression dimension had an intermediate pattern of association with ACI measures. Overall, ACI had stronger associations with ASRS-IN and SRQ-Disability and weaker correlations with ASRS-H/I. After controlling the association between the SCT 10-item version total score and ASRS-IN, the correlation between the SCT 10-item version total score and ASRS-H/I became non-significant (r = - 0.025; p > 0.01). On other

hand, the correlation between SRQ-20 Anxiety/Depression and ACI 10-item version total score when controlling ASRS-IN remained significant and with a medium size ($r = 0.448$, $p < 0.01$).

Discussion

The present study investigated preliminary evidence of the validity of the Brazilian ACI version. In terms of semantic equivalence, some items displayed differences in their content. However, the considerations of the expert panel were evaluated to improve the item wording. Overall, the equivalence was acceptable. Moreover, the ACI items showed medium to strong correlations within them as well between the total scores. The one-factor solution demonstrated satisfactory goodness-of-fit indices, replicating the finding of Becker et al. [11].

In the EFA for the estimation of convergent and discriminant validity of ACI, 10 items met the criteria. Although, these 10 items were distinct from those found in Becker et al. [11]. There was not a clear explanation of the non-reproduction of Becker et al. [11]. A hypothesis is a cultural influence on the meanings of ACI items. For example, Takeda et al. [33] did not find the same structure of an SCT scale made for U.S. adults in a Japanese sample.

Coversely, Jung et al. [34] reported that a 15-item SCT parent rating for adolescents replicated the item content in a South Korean sample. However, four items of the self-report version failed to exhibit convergent and divergent validity. These items assessed slow processing speed and mental confusion. The authors hypothesized that stigmas associated with the items' content could influence the endorsement by the adolescent. Parent and teacher versions showed consistently positive results about the validity of these items. Another source of non-replicability could be difficulty in self-evaluation regarding mental confusion and slow processing speed. Surprisingly, the present study found a satisfactory convergent and discriminant validity of items related to these SCT dimensions.

In convergence with Takeda et al. [33], SCT became non statistically significant correlated with ADHD-H/I after controlling for ADHD-IN. On the other hand, SCT symptoms remained associated with internalizing symptoms after controlling for ADHD-IN. The correlations patterns also demonstrated that SCT was stronger associated with internalizing symptoms than ADHD-IN was. This phenomenon named "dissociation" for

some authors [33] supported the singularity of SCT in relation to the ADHD-IN dimension.

The Cronbach's Alpha of the adapted ACI was satisfactory and slightly higher than the value of 0.89 reported in Becker et al. [11]. Despite the differences between the study's designs and cultural uniqueness, the internal consistency of the Brazilian version was comparable to Becker et al. [11]. Moreover, the McDonald's Coefficient and the Composite Reliability index supported the consistency of the final 10-item

Limitations

First, selection bias is a potential source of concern. The participants were recruited from the community by virtual advertisements in social media and the word of mouth. A personal interest in ADHD (e.g., a positive diagnosis) could be a reason for the participation. We found a higher proportion of ADHD diagnoses compared to the populational prevalence. Also, we did not perform a specific clinical evaluation about the psychiatric status of these individuals.

Second, the data were collected based solely on self-report rating scales. Multimethod and multi-informant designs could be useful to minimize the limitations of a research design based on only one source. To date, there is not a gold standard interview to measure SCT symptoms which limited the validation process to scale ratings.

Third, the preponderance of women to men was high in our sample. Further investigations regarding measurement invariance should demonstrate whether this imbalance is determinant to the generalization of our results. This assumption is also true for other sociodemographic characteristics.

Fourth, using a cross-sectional study, we did not calculate test-retest reliability or the predictive validity of the ACI score for clinical purposes. Longitudinal studies using ACI would clarify this concern.

Finally, the sample size was relatively small, especially to perform Structural Equation Modelling (SEM) analysis.

Conclusion

To our knowledge, this is the first study aimed to adapt an SCT measure designed for adults in Brazil. Preliminary evidence of psychometric validity and reliability supported the use of the Brazilian Portuguese ACI version. In addition, these results contributed to the investigation of ADHD, SCT,

and internalizing symptoms. Future research should explore whether the ACI is invariant across gender, age, and educational backgrounds.

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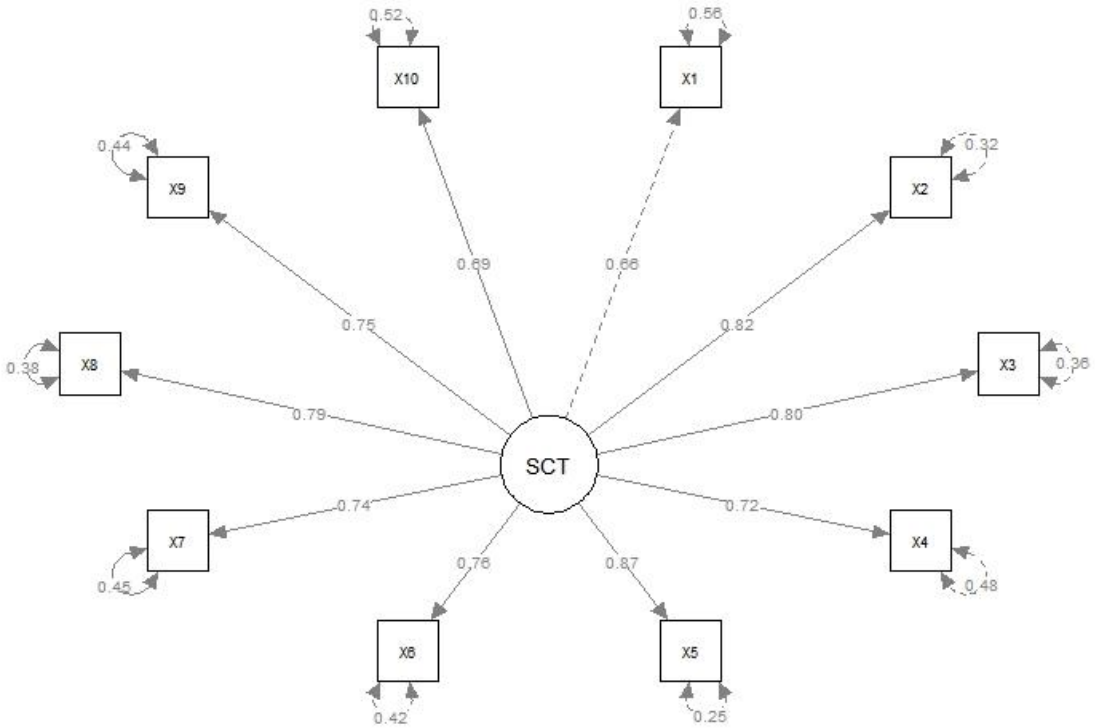

Figure 1: one-factor model of the ACI Brazilian version

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Table 1: ACI item-total scores correlations

Item	Sentence (Portuguese)	Equivalent	Partially equivalent	Not equivalent	r24	r16	r10
1	**Eu sou devagar para fazer as coisas.**	**0.9**	**0.1**	**0**	**0.594**	**0.627**	**0.666**
2	**Meus pensamentos parecem turvos, como se estivessem envoltos em neblina.**	**0.5**	**0.5**	**0**	**0.767**	**0.788**	**0.798**
3	**Eu fico olhando para o vazio.**	**0.8**	**0.2**	**0**	**0.69**	**0.727**	**0.737**
4	**Me sinto sonolento ou sem energia durante o dia.**	**0.5**	**0.3**	**0.2**	**0.698**	**0.713**	**0.743**
5	**Eu perco minha linha de raciocínio.**	**1**	**0**	**0**	**0.801**	**0.817**	**0.808**
6	**Eu não sou muito ativo.**	**1**	**0**	**0**	**0.659**	**0.693**	**0.727**
7	Eu me perco nos meus próprios pensamentos.	1	0	0	0.794	0.799	-
8	**Eu me canso facilmente.**	**0.9**	**0.1**	**0**	**0.742**	**0.748**	**0.776**
9	Eu esqueço o que eu ia dizer.	0.9	0.1	0	0.714	0.745	-
10	**Eu me sinto confuso.**	**1**	**0**	**0**	**0.787**	**0.811**	**0.799**
11	Eu não me sinto motivado para fazer as coisas.	0.8	0.2	0	0.759	0.758	-
12	Minha mente viaja longe sem que eu perceba.	0.5	0.5	0	0.763	0.785	-
13	Minha mente fica bagunçada.	0.8	0.2	0	0.823	0.830	-
14	**Meu raciocínio parece lento ou mais devagar.**	**0.8**	**0.2**	**0**	**0.666**	**0.713**	**0.756**
15	Eu sonho acordado (viajo).	1	0	0	0.682	0.695	-
16	**Eu sinto dificuldade para colocar meus pensamentos em palavras.**	**0.8**	**0.2**	**0**	**0.691**	**0.712**	**0.716**
17	Trabalho ou emprego	1	0	0	0.711	-	-
18	Educação ou estudos	0.8	0.2	0	0.749	-	-
19	Relacionamentos com amigos.	1	0	0	0.657	-	-
20	Relacionamentos com parceiros românticos.	0.9	0.1	0	0.621	-	-
21	Criação dos filhos	0.9	0.1	0	0.369	-	-
22	Organização da rotina	0.9	0.1	0	0.734	-	-
23	Cuidados diários (banho/higiene pessoal, exercício físico, alimentação).	0.8	0.2	0	0.642	-	-
24	Conseguir ter uma boa noite de sono.	0.9	0.1	0	0.513	-	-
	Full scale	0.85	0.142	0.008	-	-	-
	16-item version	0.825	0.1625	0.0125	-	-	-
	10-item version	0.82	0.16	0.02	-	-	-

Note: Items in bold are included in the final 10-item version. All correlations were significant at $p < 0.01$. r24: Pearson correlations with the 24-item ACI total score; r16: Pearson correlations with the 16-item ACI total score; r10: Pearson correlations with the 10-item ACI total score.

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Table 2: ACI inter-item correlations

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1															
2	.444**	1														
3	.401**	.639**	1													
4	.432**	.480**	.486**	1												
5	.464**	.589**	.552**	.559**	1											
6	.522**	.471**	.437**	.571**	.484**	1										
7	.414**	.626**	.551**	.478**	.681**	.510**	1									
8	.427**	.531**	.494**	.733**	.625**	.595**	.527**	1								
9	.384**	.495**	.520**	.500**	.714**	.426**	.593**	.553**	1							
10	.413**	.699**	.571**	.493**	.664**	.470**	.624**	.520**	.620**	1						
11	.485**	.550**	.459**	.601**	.563**	.610**	.550**	.597**	.497**	.590**	1					
12	.424**	.552**	.558**	.466**	.586**	.463**	.714**	.479**	.557**	.586**	.569**	1				
13	.404**	.710**	.568**	.492**	.650**	.449**	.700**	.544**	.545**	.758**	.585**	.708**	1			
14	.522**	.598**	.506**	.451**	.563**	.462**	.441**	.487**	.517**	.590**	.510**	.467**	.542**	1		
15	.386**	.479**	.485**	.412**	.511**	.379**	.594**	.425**	.489**	.507**	.439**	.702**	.623**	.378**	1	
16	.414**	.537**	.459**	.391**	.589**	.464**	.535**	.418**	.531**	.586**	.478**	.524**	.607**	.515**	.453**	1

Note: ** = significance level at p < 0.01

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Table 3: exploratory factor analysis results for the ACI Brazilian version, ASRS-IN and SRQ-20 Anxiety/Depression

	Sample A			Sample B		
Item	**SCT**	**ADHD-IN**	**ANX/DEP**	**SCT**	**ADHD-IN**	**ANX/DEP**
SRQ2		0.421				0.315
SRQ6			0.525			0.575
SRQ9			0.889			0.682
SRQ10	-0.338		0.749			0.555
SRQ15			0.722			0.743
SRQ16			0.659	0.362		0.713
SRQ17			0.904			0.813
ASRS1		0.693			0.912	
ASRS2		0.908			0.916	
ASRS3	0.336	0.556			0.777	
ASRS4		0.929			0.778	
ASRS5		0.985			0.831	
ASRS6		0.800			0.857	
ASRS7		0.900			0.945	
ASRS8		0.870			0.844	
ASRS9		0.662			0.642	
ACI1	0.657			0.757		
ACI2	0.648			0.793		
ACI3	0.616			0.730		
ACI4	0.724			0.577		
ACI5	0.817			0.764		
ACI6	0.668			0.882		
ACI7	**0.524**	**0.350**		**0.489**	**0.423**	
ACI8	0.705			0.656		
ACI9	**0.791**			**0.520**	**0.436**	
ACI10	0.746			0.787		
ACI11	**0.483**			**0.510**		**0.416**
ACI12	**0.459**	**0.467**		**0.307**	**0.495**	
ACI13	**0.375**	**0.456**		**0.510**	**0.307**	
ACI14	0.660			0.865		
ACI15	**0.429**	**0.359**		**0.450**		
ACI16	0.694			0.561		

Note: Factor loadings above 0.3 are omitted. Items in bold did not reach the criteria for divergent validity. **SCT** = Sluggish Cognitive Tempo; **ADHD-IN**: Attention deficit hyperactivity-disorder inattention symptoms; **ANX/DEP**: anxiety/depression.

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Table 4: standardized factor loadings of the 10-item ACI version

Item	Loadings
ACI1	0.663
ACI2	0.823
ACI3	0.799
ACI4	0.720
ACI5	0.866
ACI6	0.762
ACI8	0.739
ACI10	0.786
ACI14	0.750
ACI16	0.693

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Table 5: correlations between ACI measures, ASRS-18 dimensions and SRQ-20 factors

Scale/Dimension	ACIFull	ACI16	ACI10	SRQTotal	SRQAnxDep	SRQDisab	SRQSomatic	ASRSTotal	ASRS-IN	ASRS-H/I
ACIFull	1									
ACI16	0.973	1								
ACI10	0.943	0.977	1							
SRQTotal	0.749	0.738	0.727	1						
SRQAnxDep	0.625	0.618	0.605	0.891	1					
SRQDisab	0.780	0.769	0.763	0.929	0.833	1				
SRQSomatic	0.524	0.517	0.509	0.808	0.564	0.595	1			
ASRSTotal	0.758	0.726	0.652	0.628	0.502	0.615	0.485	1		
ASRS-IN	0.805	0.785	0.726	0.589	0.455	0.615	0.412	0.908	1	
ASRS-H/I	0.541	0.501	0.428	0.536	0.446	0.48	0.462	0.885	0.608	1
Cronbach α	0.95	0.947	0.92	0.874	0.754	0.860	0.602	0.929	0.926	0.875

Note: ACIFull = 24 items of ACI; ACI16 = 16-item ACI version; ACI10 = 10-item ACI version; SRQTotal = total sum of the 20 items of SRQ; SRQAnxDep = factor of the SRQ-20 related to anxious and depressive symptoms; SRQDisab = SRQ-20 factor called Disability; SRQSomatic = factor of the SRQ-20 related to somatic concerns; ASRSTotal = total score of ASRS=18; ASRS-IN = total score of inattention symptoms of ASRS-18; ASRS-H/I = total score of the hyperactivity-impulsivity dimension of ASRS-18.

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