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Cross-cultural adaptation of the Battelle Development Inventory, 2nd Edition for Brazil

Adaptação transcultural do Battelle Developmental Inventory, 2nd Edition para o Brasil

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Abstract

The Battelle Developmental Inventory, 2nd Edition is a standardized inventory for evaluating the child development from birthto seven years, 11 months old. The objective of this article is to describe the process of cross-cultural adaptation of the Battelle Developmental Inventory, 2nd Edition Protocolto Portuguese-Brazil. This methodological study was conducted in three steps: 1) Pre-condition; 2) Test development; and 3) Evaluation of content validity. Adjustments were performed in the formulation of some items, as well as in the stimuli for structured application of the Brazilian version of Battelle Developmental Inventory, 2nd Edition. Compared to the original version, the Brazilian version showed good semantic, idiomatic, experiential, conceptual, and operational equivalences, as well as excellent content validity indexes. This adapted version of the Battelle Developmental Inventory, 2nd Edition for Brazil can be considered aviableinstrument for the usewith a Brazilian infant and child population.

Keywords: Child development; Development measures; Scales; Translating.

Resumo

O Battelle Developmental Inventory, 2nd edition *é um inventário padronizado para avaliação do desenvolvimento de crianças de zero a sete anos e 11 meses de idade. O objetivo desse artigo é descrever o processo de adaptação transcultural do* Battelle Developmental Inventory, 2nd Edition *para o português-Brasil. O estudo metodológico foi realizado em três*

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etapas: 1) Pré-condição; 2) Desenvolvimento do teste; e 3) Avaliação da validade de conteúdo. Foram feitos ajustes na formulação de alguns itens, além de modificações nos estímulos para aplicação estruturada da versão brasileira do Battelle Developmental Inventory, 2nd Edition. *Comparada com a versão original, a versão brasileira apresentou boa equivalência semântica, idiomática, experiencial, conceitual e operacional, bem como ótimos índices de validade de conteúdo. A versão adaptada para o português-Brasil do* Battelle Developmental Inventory, 2nd Edition *pode ser considerada um instrumento viável para uso de profissionais das áreas de saúde e da educação do país.*

Palavras-chave: *Desenvolvimento infantil; Medida do desenvolvimento; Escalas; Tradução.*

The assessment of child development can be understood as an evaluation process of abilities and competencies that children acquire in the systematic interactions between he or she and their different developmental contexts (Sameroff, 2009). For an authentic evaluation process, it is important to use reliable and valid developmental scales, that represents a challenge for professionals and researchers who work on child development (Richardson, 2010; Lee et al., 2016). Overall, the number of available assessment scales has increased, especially in English-spoken countries (Coster & Mancini, 2015). The development of new assessment tools is expensive, time-consuming, and sometimes its cost is prohibitive because of the long time for a complete test development (Streiner et al., 2015), especially in Brazil where the financial resources are insufficient (Cassepp-Borges et al., 2010). Furthermore, the lack of Brazilian versions of assessment tools has implications for child developmental researches, due to the difficulties in comparing data from Brazilian studies with international findings (Pacico, 2015).

To meet the need for child development assessment scales in Brazil, international tools are adapted. However, due to the differences between cultural contexts, the semantic, idiomatic, conceptual and cultural equivalences between the adapted and the original versions must be analyzed in a rigorous process (Beaton et al., 2000; Damásio & Borsa, 2017). Usually, the using of simple translations of international tools is common in Brazil (Albuquerque & Cunha, 2020). Nevertheless, the International Test Commission (ITC) highlights that the "translation" represents only the first step of a rigorous process of a cross-cultural adaptation (International Test Commission [ITC], 2016). According to the ITC Guidelines (ITC, 2016), this process involves 18 steps or guidelines, organized in six categories: 1) Precondition; 2) Test development; 3) Confirmation; 4) Administration; 5) Scoring and interpretation, and 6) Documentation. The first two categories of ITC Guidelines (ITC, 2016) were adopted on this study in order to purpose a cross-cultural adaptation of the Battelle Developmental Inventory, 2nd edition (BDI-2) for Brazil. This includes the verification of content as well as the permission to conduct the transcultural adaptation (Precondition) and to follow the guidelines for the translation and adaptation of test for the target population (Test Development).

The BDI-2 is an assessment scale internationally used to evaluate the developmental skills of children from birth to 7 years and 11 months of age (Newborg, 2005). It was originally published in English by Newborg in 1984 (Newborg et al., 1984). Since this first publication, the Battelle Developmental Inventory (BDI) has been considered widely used tool for evaluating the early child development, especially in the United States of America, but also in countries whose primary language is Spanish (Alfonso et al., 2010). A revised version of this tool was published in 2005: the Battelle Developmental Inventory, 2nd Edition (BDI-2) (Newborg, 2005).

The BDI-2 was developed based on the concept of developmental milestones, which assumes that the child development follows a process of skills or critically important behaviors being acquired by following a specific sequence, whereby each skill depends on the prior acquisition of a specific competence (Papalia & Feldman, 2013). The BDI-2 allows the long-term monitoring of the child population, as well as providing guidance for planning interventions and evaluating their efficacy (Mancías-Guerra et al., 2014). The BDI-2 has a complete version with 450 items across five developmental domains (adaptive, personal-social, communication, motor, and cognitive), and a screening version with 100 items. Both versions are available in

English and Spanish, although normative data and psychometric studies are restricted to the English version (Newborg, 2005).

The original standardization study of the BDI-2 was conducted with a sample of 2500 children, stratified by geographic regions from the USA, and controlled by sex, age and social-economic level (Newborg, 2005). A systematic review of the BDI-2 studies from 2005 to 2015 showed that the researchers highlight the excellent psychometric properties of this inventory (Cunha et al., 2018). Validation of content and criteria of the BDI-2 showed good results. Correlations between BDI-2 and other gold-standard assessment scales were acceptable, ranging from 0.64 to 0.76 for domain scores, and 0.78 for the total BDI-2 score. The BDI-2 internal consistency coefficients are excellent (0.85 to 0.99), as well as the test-retest reliability coefficients, that rate over 0.87 for the total score and for all the BDI-2 domains (Newborg, 2005).

Considering the lack of child development assessment tools available in Portuguese-Brazil language, cross-cultural adaptation studies of valid, robust and reliable assessments tools, like the Battelle Developmental Inventory, 2nd edition, are very important for Brazil, especially considering their using for the monitoring of health and child development. Based on this, the purpose of this study was to describe the cross-cultural adaptation process of the BDI-2 for Brazil, including the evaluation of semantic, idiomatic, experimental, conceptual and operational equivalencies, in addition to the content validation of a Brazilian-Portuguese BDI-2 version.

Methods

This is a methodological study for a cross-cultural adaptation of the Battelle Developmental Inventory-2nd Edition (BDI-2) based on the ITC Guidelines (ITC, 2016). The guidelines 1 (Pre-condition) and 2 (Test Development) of the ITC Guidelines were adopted to conduct the first and second stages of this study, while the Hernández-Nieto's (2002) proposal was used to analyze the content validation of the Brazilian version of BDI-2 in a third study stage. Content validation is related to the measurement of how much the scale items are representative of the constructs (and its domains) measured by an instrument (Streiner et al., 2015).

Instrument

It is important to highlight that the BDI-2 is an assessment inventory standardized to measure the child's abilities from zero to seven years and 11 months of age (Newborg, 2005). The scale assesses the development based on five domains Adaptative, Personal-Social, Communication, Motor, and Cognitive. These domains are comprised of two to three subdomains with specific number of items: (1) Adaptive (ADP): a) Self-Care (SC): 35 items; (b) Personal Responsibility (PR): 25 items; 2) Personal-Social (P-S): a) Adult Interaction (AI): 30 items; (b) Peer Interaction (PI): 25 items; (c) Self-Concept and Social Role (SR): 45 items; (3) Communication (COM): (a) Receptive Communication (RC): 40 items; (b) Expressive Communication (EC): 45 items; 4) Motor (MOT): (a) Gross Motor (GM): 45 items; (b) Fine Motor (FM: 30 items; (c) Perceptive Motor (MP): 25 items; and (5) Cognitive (COG): (a) Attention and Memory (AM): 30 items; (b) Reasoning and Academic Skills (RA): 35 items; (c) Perception and Concepts (PC): 40 items.

Each BDI-2 test item offers one to three formats of administration: (a) child observation; (b) interview with parents and/or caregivers; and (c) structured situations involving interactions with children using toys, games and tasks. The child's performance is evaluated based on standard criteria, using a simple three-point scoring system, being 0 = unable, 1 = emerging skill, and 2 = mastered skill. The standard scores for each domain are referred to as Developmental Quotient (DQ) ratings, with an average of 100 and a standard deviation of 15.

Procedures for Cross-cultural Adaptation

The study was performed in three stages: Stage (1) Precondition: this includes the verifying whether overlaps in the definition and in the content of variable measured are sufficient for the use of the BDI-2 to evaluate the target population in Brazil, as well as the permission to conduct the transcultural adaptation by the holder of BDI-2´s intellectual property rights; Stage (2) Test development: this includes the following of guidelines for translation and adaptation of the test to guarantee the adequacy of the adapted version, and the equivalences between the original and the adapted version for the target population; and Stage (3) Validation of the content: this includes the assessment of clarity, adequacy, and theoretical relevance of the adapted version for the new cultural context based on the experts opinions (Cassepp-Borges et al., 2010; Hernández-Nieto, 2002).

Stage 1 – Precondition

To start the adaptation process, the adequacy of BDI-2 for the development assessment (global and by domains) for the Brazilian child population was evaluated based on the analysis of Brazilian policies related to the health and child development (Ministério da Saúde, 2016, 2018). Furthermore, the BDI-2 was presented to experts for discussion in professional meetings, as well as by consultation via email. Also, a systematic review of BDI-2 studies and their use in different populations was conducted (Cunha et al., 2018). Finally, the permission to conduct this cross-cultural adaptation study was requested from the Houghton Mifflin Harcourt, the company that holds the intellectual property rights of BDI-2.

Stage 2 – Test Development

The test development of the Brazilian version of the BDI-2 involved specific sub-stages, based on four out of the five guidelines of the Test Development phase from the ITC Guidelines (Table 1).

Table 1
Sub-stages of the Test Development stage, according to the International Test Commission Guidelines

Sequence	Procedures
1	Ensure that the translation and adaptation processes included linguistic, psychological, and cultural differences for the target populations through the choice of experts with relevant knowledge
2	Use appropriate judgmental designs and procedures to maximize the suitability of the test adaptation in the targetpopulations
3	Provide evidences that the test instructions and item content have similar meaning for all target populations
4	Collect pilot data using the adapted test to proceed the item analysis, and revisions in to the adapted version, if necessary

In all four sub-stages, the cross-cultural adaptation process sought to guarantee semantic (literal translation of words), idiomatic (colloquialisms and linguistic expressions), experiential (applicable to an unfamiliar culture), conceptual (the concept of evaluated phenomenon) and operational (instrument application) equivalences were conducted, as, described below.

Stage 2.1

To guarantee the linguistic and cultural differences for the target population, the cultural adaptation process was performed by experts with relevant experience on child evaluation. Also, two translations

(Translation 1-T1 and Translation 2-T2) of the BDI-2 original (English version) into Brazilian-Portuguese were done. These translations were performed by two independent professionals with training in child development who were fluent in both Brazilian-Portuguese and English languages. Following that, T1 and T2 versions were compared to propose a first overview-version (T3) that included items of both versions, and modifications in some items to improve the equivalences between translated versions. The items in the overview-version were analyzed by three independents PhD experts in child development: two psychologists and one occupational therapist. Based on a five-point Likert scale (1 = very low degree, 2 = low degree, 3 = average, 4 = high degree, and 5 = very high degree), the experts evaluated the clarity of language related to the theoretical pertinence and relevance of the translated version. This Likert scale was used to evaluate the content validation of the adapted version in Stage 3 (Cassepp-Borges et al., 2010; Hernández-Nieto, 2002). The experts could suggest item modifications, which were included into a second version revised.

Stage 2.2

To maximize the adequacy of the test for the target groups, the reviewed version was retranslated by a third North American translator, native English speaker and fluent in Portuguese language. Subsequently, this retranslated English version was evaluated by a co-author of this paper, who is a North American native English speaker from the U.S. and pediatric psychologist (PhD) with large experience in the use of BDI-2. At this stage, two distinct equivalences were considered: (a) the literal, or denotative, equivalences between the terms/words of the original BDI-2 items and the retranslated version items; and (b) the general sense, or connotative, equivalences of each BDI-2 item, comparing the each item formulation of retranslated version to the original version (Reichenheim & Moraes, 2007).

Stage 2.3

To provide evidences of meaning similarities between the test instructions and item content for all target populations, a prototype version was presented to different groups. First, the items were presented to caregivers and parents (n = 32) of children in the age ranges evaluated by the BDI-2. They were requested to evaluate the clarity of items, and to suggest modifications in their formulation. Additionally, child health professionals (n = 6), like psychologists and occupational therapists, were requested to apply the Brazilian version of the BDI-2 and evaluate the items formulations and application instructions, and the response scale.

Stage 2.4

Finally, a pilot-study was conducted using that prototype version for item analysis and final revision. The prototype version was administered to a convenience sample of 32 typical Brazilian children. The sample size was based on the Beaton's et al. (2000) recommendations, and the sample was stratified by sex, socioeconomic levels and age ranges. Eight groups of four children each were recruited: (1) 0 to 11 months; (2) 12 to 23 months; (3) 24 to 35 months; (4) 36 to 47 months; (5) 48 to 59 months; (6) 60 to 71 months; (7) 72 to 83 months; e (8) 84 to 95 months. The data collection was conducted after the Committee for Ethical Research of the *Universidade Federal do Espírito Santo* (UFES) (CAAE nº 62650416.4.0000.5060) approval. The parents were invited to be a part on the study, when they signed a Full Consent Form.

All children were evaluated using the adapted version of the Battelle Developmental Inventory – 2nd Edition (BDI-2) for Brazil, following the original instructions and classification test. It should be noted that the ITC Guideline recommends to "provide evidence that the format of items, assessment scales, score categories,

test conventions, administration methods, and other procedures are suitable for all target groups" (ITC, 2016, p.15); however, in the BDI-2 cross-cultural adaptation process, there were no modifications made in those aspects. The administration, as well as the scoring system were not modified in the adaptation process. The original BDI-2 scoring and administration instructions were used in this study.

A trained examiner applied the adapted version using the Battelle kit following those formats of administration testing (observation, structures activity or interview) as recommended in the BDI-2 manual. The data collection of this study was scheduled and conducted at the LAPEPP-PPGP UFES, Laboratory of Research in Pediatric Psychology of the Graduation Program in Psychology of UFES, Brazil.

The data on the semantic, idiomatic, experiential, conceptual, and operational equivalencies were analyzed qualitatively, integrating different information obtained from Stage 2.

Stage 3 – Content Validity Assessment

As described in Stage 2.1, the content validity of the Brazilian version of BDI-2 was analyzed by three independent experts, with PhDs in child development, who evaluated: (a) the language clarity of item formulations; (b) the content relevance to the Brazilian population; and c) the theoretical relevance related to the measured construct. A five-point Likert scale was used to assess the Content Validity Coefficients (CVC) and the Total Content Validity Coefficients (CVCt). Both coefficients (CVC and CVCt) were calculated to identify items that were not suitable for the assessment goal. Items that obtained CVC and CVCt≥ 0,80 were considered valid (Hernández-Nieto,2002).

Results

Stage 1 – Precondition

At this first stage, Brazilian policies related to child health and infant development monitoring (Ministério da Saúde, 2016, 2018) were analyzed, and the opinion of infant development experts about the BDI-2 were collected. The Brazilian experts suggested that the conceptual assumptions and the structure (domains) of BDI-2 could be remained for Brazilian children. All of those were analyzed qualitatively considering the results from a systematic review of BDI-2 studies (Cunha et al., 2018). We concluded that the conceptual and methodological assumptions of the BDI-2 are applicable to the cultural context of the Brazilian early childhood population. Based on this, the permission to conduct this cross-cultural adaptation study was requested and obtained from the Houghton Mifflin Harcourt, the company that holds the intellectual property rights of the BDI-2.

Stage 2 – Test development

At this stage, the translation and retranslation, specialist evaluation of translated and retranslated versions, and target-public assessment of BDI items suggested adjustments in the item's formulation. Those adjustments were performed according to the BDI-2 manual and their test books. Strategies of exemplification, addition, omission, or substitution of words were adopted to guarantee the semantic, idiomatic, experiential, and conceptual equivalences between the original and the Brazilian versions, as described in the Table 2.

These strategies were used in 41 total instances to adjust the Brazilian version of the BDI-2. The majority of adjustments were substitutions (n = 22), followed by additions (n = 10), omissions (n = 6), and inclusion of examples (n = 3).

Table 2

Type of adjustment strategies per domains for the Brazilian adapted version of Battelle Developmental Inventory – 2nd edition

Domain	Items	Adjustmentstrategies[b]				Total
BDI-2[a]		EX	AD	OM	SUB	
ADP	60	1	3	2	3	9
P-S	100	1	3	1	3	8
COM	85	0	1	2	5	8
MOT	100	1	1	1	8	11
COG	105	0	2	0	3	5
Total	450	3	10	6	22	41

Note: [a]Domains: ADP: Adaptive; P-S: Personal-Social; COM: Communication; MOT: Motor; COG: Cognitive. [b]Strategies: EX: Exemplification; AD: Addition; OM: Omission; SUB: Substitution.

Substitution was the strategy used to adjust the grammar of some item's transcription and instructions. For example, in the Item CR28 "*The child understands irregular plural forms*", the translation would be "irregular" in Portuguese. However, it was replaced by the word "specific", because the plural in Brazilian Portuguese has specificities and not irregularities. Other words in items formulation were also replaced by equivalent expressions with cultural meaning, like in the Item AM10 – "The child attends to a game of peekaboo for 1 minute", that the expression "Peekaboo" (childhood game of covering and uncovering your face and saying Peekaboo!) was replaced by the expression "*Achou!*", that corresponds to a similar game in Brazil.

The addition strategies were used to clarify some items formulation. For example, the expert suggested that the formulation of Item PI15 – "The child willingly takes turns and shares" was not clear, and the words "*materiais de brincadeiras*" (play materials) were added to improve this clarity.

The omission of words and terms was adopted, especially when two terms in English had the same semantic meaning in Portuguese. For example, the item PM25 – "The child writes in script (cursive) rather than printing" was translated without the term "in script" considering that the word "cursiva" ("cursive" in Portuguese) was enough.

The expert suggestions were also considered to improve and increase the clarity of items formulations. For example, in the item SC29 – "The child takes care of his or her own toileting needs" – examples of those needs were added: "The child takes care of his or her own toileting needs, including getting undressed, cleaning herself, and getting dressed again". The same was performed for item SR25 – "The child recognizes the facial expressions of primary emotions", where it was added: "[...] (happy, sad and angry)" to exemplify those primary emotions. Also, in the item GM24 - "The child maintains or corrects his or her balance when moving from a standing position to other, non-vertical positions" examples ("[...] (ex: bending down or walking across an uneven surface) were added. All those adjustments were suggested by experts based on the description of the items.

The data from the evaluation of translated and retranslated versions of the BDI-2 was analyzed, and the findings suggested a good equivalence between those two versions. From the total of 450 items, only 39 of the retranslated version presented a degree of equivalence in literal meaning lower than 80%. It was also noted that the connotative meaning did not change or were only slightly altered in more than 86% of the items.

The analysis of idiomatic, experiential, and conceptual equivalences indicated a high quality of the adapted version of BDI-2 by the target-population evaluation. According to parents' opinions, the questions used to administer the items using the interview format were clear and easy to answer. Likewise, the experts considered that the item´s instructions were understandable, as well as the response scale was intelligible and appropriate for the evaluation of Brazilian children.

Modifications in the stimulus material of some items were also necessary to guarantee the operational equivalence. For this, some material was adapted to the Portuguese language, as well as for the Brazilian cultural background. Overall, 19 graphical adaptations were performed for 9 items (Table 3).

Table 3

Examples of graphical adaptations of the adapted version of Battelle Developmental Inventory – 2nd edition for Brazil

Item	Description	Original stimuli		Adapted stimuli
AC26	The child chooses the appropriate utensil for the food he or she is eating/*A criança escolhe o talher apropriado para o alimento que ela está comendo*	Image of a Apple souce	Apple sauce	 *Iogurte*
CR24	The child understands simple negations/*A criança entende negações simples*	Image of an unbuckled belt	Buckled/ unbuckled	 *Amarrado/ desamarrado*
CR34	The child selects the word that rhymes from a picture set/*Seleciona a palavra que rima com um conjunto de figuras*	Image of a duck	Truck/ duck	 *Caminhão/ tubarão*
CR35	The child selects the word with the same beginning sound from a picture set/*Seleciona a palavra com o mesmo som inicial de um conjunto de figuras*	Image of a truck	Truck/ train	 *Trator/ trem*
EC36	The child uses the irregular past tense of verbs/*Usa verbos irregulares no passado*	Image of a boy eating	Eat/ ate	 *Dormir/ dormiu*

The correspondence between content and form were maintained for every graphical adaptation. In most of them, the illustrations from other BDI-2 items were used to replace the images that did not correspond to the Portuguese language and Brazilian cultural background. For example, the crayon picture ("*giz*" in Portuguese) from the Item AM24 was used to replace the picture of a "match" ("*fósforo*") used to the Item EC34 "The child uses plural forms ending in the /ez/ sound", because the translation of the word match does not have an /es/ final sound in Portuguese.

Only 10 new illustrations were inserted in the adapted version, all were performed by a professional designer, and tested in the pilot-study. For example, in the Item RC24 "The child understands simple negations", the figure of an unbuckled belt (a term that Brazilian children from five to seven years old found hard to understand) was replaced by the figure of an untied sneaker. While in the Item SC26 – "The child chooses the appropriate utensil for the food he or she is eating", the figure of a standard American brown sausage was replaced by the illustration of a red sausage, more common in Brazil, and easily recognized by the children in the pilot-study.

A total of 34 adaptations in the stimuli of items applied in a structured situation were performed for nine items. For instance, in the Item SR34 – "The child recognizes the feelings of others", the "baseball" team was replaced by the "football" team, since football (soccer in the U.S.) is a more common sport in Brazil. Likewise, the derogatory expression "string bean" was replaced by "*magricela*" in the story of Item SR36 – "The child discriminates between socially acceptable and unacceptable behavior". The expression

"*magricela*" was acknowledged as derogatory by the Brazilian kids in the pilot-study. Most of those modified stimuli preserved the original proposal of the item, keeping the requested phonemes. For example, in the Item RC36 – "The child identifies the initial sound in words", the phonemes /s/, /f/ and /p/ were replaced by equivalent word phonemes in the Portuguese language. The following alterations were performed: (a) "*santa/anta*" instead of "sold/old"; (b) "*foca/oca*" instead of "fall/all"; and(c) "*pilha/ilha*", instead of "pill/ill".

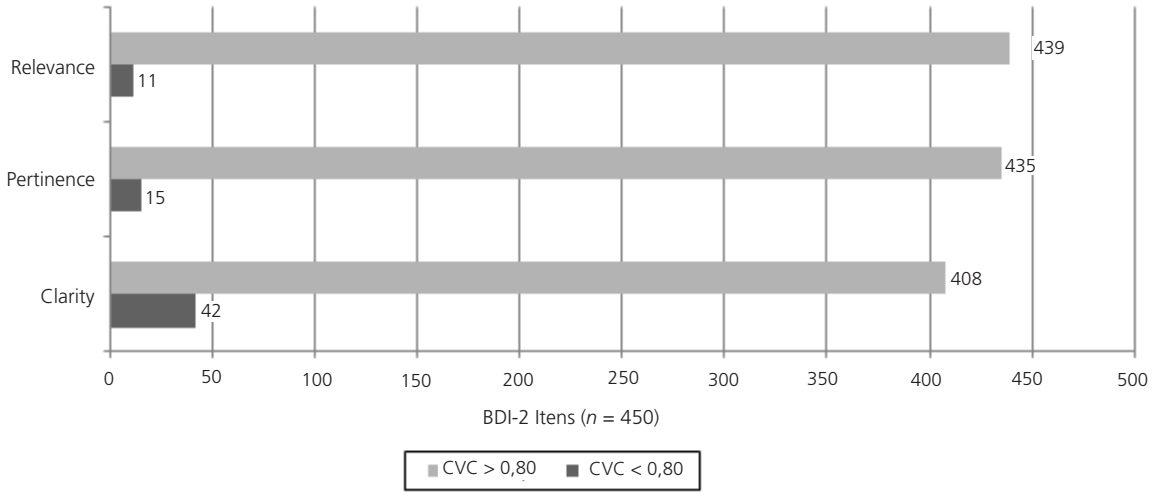
Graphical and stimulus modifications were performed before, but also during the pilot-study, due to the children's difficulties with some items. For some item, like Item RC35 – "The child selects the word with the same beginning sound from a picture set", the drawing of a "hat" ("*chapéu*" in Brazilian Portuguese) replaced a "top hat" ("*cartola*") because children did not recognize this stimuli in the pilot study. Because of this, the initial sound of the word stimuli was modified. Administration of the complete adapted BDI-2 assessment tool lasted between 60 and 100 minutes with each child.

Stage 3 – Content validity assessment

In the last study stage, the content validity of the adapted version of the BDI-2 for Brazil was analyzed. The results suggested that this version showed good indexes of Content Validity Coefficients (CVC) and Total Content Validity Coefficients (CVC *t*), according to the cut-off point (≥ 80) suggested by Hernández-Nieto (2002). The CVC *t* indexes for the language clarity (CVC *t* = 0.89), cultural pertinence (CVC *t* = 0.90), and theoretical relevance (CVC *t* = 0.92) were all above 0.80. The Figure 1 presents the content validity analysis results.

For all Content Validity Coefficients analyzed (clarity, cultural pertinence and theoretical relevance), only six items obtained CVC < 0.80.

Figure 1
Content validity analysis



Discussion

The cross-cultural adaptation of assessment tools is very important, since it allows the understanding and the comparison of assessment results from studies conducted in countries with different cultures. Our findings suggested that our version of the BDI-2 for usein Brazil can be a good and well adapted assessment

tool to evaluate the Brazilian child population. The results of this study showed that the cross-cultural adaptation of BDI-2 for Brazil was successful, because its methodological process was based in a rigorous application of different adjustments strategies and procedures to guarantee an appropriate BDI-2 version for use in Brazil. This adapted version was tested and analyzed in comparison to the original version for some predefined types of equivalence (semantic, idiomatic, experiential, conceptual and operational), all essential for this type of methodological study (Borsa et al., 2012; ITC, 2016).

The monitoring of child's health and the screening of infant development are mandatory to guarantee Brazilian public policies like the "*Política Nacional de Atenção Integral à Saúde da Criança*" (National Policy for an Integral Infant Healthcare). This policy considers that the early identification of development delays is critical for the Brazilian child population (Ministério da Saúde, 2018). In this way, it is fundamental to promote children's development, with the monitoring of physical growth and neurological, behavioral, cognitive, social and emotional maturing of the child. Children's development must be assessed in terms of the developmental milestones at each age range (Ministério da Saúde, 2016), that is the same principle of the BDI-2 proposal. The BDI-2 purpose to understand the infant and child development as a phenomenon that can be evaluated across multiple domains, composed by specific child abilities that must to be measured carefully.

Although the definition and content of the construct "development" is universally defined, the differences between the Brazilian and American language and culture determined the necessity to perform some adjustments in the item´s formulations and administration of BDI-2. Adjustments strategies, such as the addition of words, omission, replacement and provision of examples, were used to approximate the adapted version of BDI-2 to the different Brazilian social and cultural realities, ensuring that the translated words and expressions remained consistent with the concepts being measured by the BDI-2 (Newborg, 2005). The translation of item MG13 – "The child sits without assistance for at least 5 seconds" was an example of this. At the 2.2 stage, it was necessary to determine if the item was referring to a static or dynamic (mobile) position. Considering that the literal translation – "*senta*" – refers to sit down (action) and not to the sitting situation, the term "sits" was translated as "*permanence sentado*" ("remains seated"). The same strategy was used by Mancini et al. (2016) in the adaptation of a tool to evaluate child and juvenile functional performance, demonstrating the use fullness of this strategy in similar studies.

Conducting a cross-cultural adaptation process based on a rigorous method is essential to develop a valid version for use with the target-population. This process is crucial to ensure that the properties of the instrument and its use in a language and culture different from its original version are appropriate. This is a challenging process, especially because of the specific life experiences inherent in different cultures (Coster & Mancini, 2015; ITC, 2016). The methodology adopted on this study, based on a meticulous planning of procedures following international guidelines specific for this type of study (ITC, 2016), was one of the strategies used to overcome those challenges.

Besides the culture background, the child's development assessment is based on the social and evolutionary changes during their developmental trajectory. Considering that the child develops through the acquisition of abilities and competences constructed in their transactions with the different contexts of day-to-day life (Sameroff, 2020; 2009), the historical-cultural events and the social expectations related to the infancy have influences on the child's evaluation. Therefore, the developmental assessment measures need to be reviewed periodically (Richardson, 2010; Streiner et al., 2015). During our cross-cultural adaptation process, for instance, the item SC22 – "The child asks for food at the table" was reviewed because the term "at the table" does not fit at this time in Brazil cultural context. In Brazil, many families no longer have the habit of eating at the table. Based on that item description, and following the expert suggestions, the word "verbally" was included to guarantee the clarity and the relevance of item SC22, without adversely affecting the evaluation. Another example was the item PR19 – "The child uses the telephone to place a call", where the term "cell phone" was included in the Portuguese version, because it reflects a cultural

aspect of Brazilian society, as well as the historical transformations of the worldwide background, where the technological changes are frequent around the world, since the last original revision of the BDI in 2005.

It's important to highlight that the content validity of this adapted version, analyzed for the language clarity and the theoretical pertinence and relevance, adhered to the parameters accepted by the literature (Cassepp-Borges et al., 2010; Hernández-Nieto, 2002). Therefore, the content of adapted version was suitable for the assessment of child development in Brazil. The items with a CVC lower than 0.80, and that were administered by interview or observation were adjusted, according to expert´s suggestions and following the Hernández-Nieto (2002) proposal. For the items with CVC higher than 0.80, it was considered that the description of item application and its materials were enough to provide the necessary clarity. We can suggest that the low CVC indexes of some items can be related to expert´s difficulties to evaluate them without the full BDI-2 test manuals using only by the protocol translations.

Moreover, it also should be highlighted that the cross-cultural adaptation stages were planned following a rigorous methodology that is important for this type of study. So, the problems of the semantic, idiomatic, conceptual, experiential and operational discrepancies could be resolved. According to this, the problem solutions during the BDI-2 cross-cultural adaptation were proposed in an integrated way. Suggestions from each type of target population, from experts to parents and even the children evaluated on this study, were included in the adaptation process. In addition, the use of the prototype version showed that the Brazilian version was clear and understandable for families with different socioeconomic status and levels of education. Thus, the BDI-2 version adapted for the Brazilian population can be considered as a viable instrument that will be available in the future for use by Brazilian health and education professionals, as well as for researches and clinical applications in countries whose primary language is Portuguese. However, for this it will be necessary to obtain a commercially available version of the adapted version of BDI-2.

Even though the adapted version of BDI-2 for Brazil can be considered a good tool for use to evaluate Brazilian early childhood population, some study limitations should be pointed. First, this adapted version was tested only in a pilot study conducted with children from one Brazilian state. This sample does not reflect the regional diversities in a country like Brazil with continental dimensions. On the other hand, it's important to note that the adapted version was evaluated by children´s parents from different socio-economic backgrounds, which suggests that this version has potential to be used for diverse populations from different economic status, that is common among the Brazilian population. Nevertheless, further studies should be conducted using this version with samples of child and their parents from different regions of Brazil. Therefore, it is necessary to examine potential modifications that may be needed for a national version of the BDI-2 in order to allow for the assessment of similarities and differences in child development patterns throughout the country. Future studies must also suggest testing other psychometric parameters of Brazilian BDI-2, besides the evidence of content validity found in this study. In order to guarantee the validity and reliability of the Brazilian Portuguese version of the BDI-2, additional psychometric studies are highly recommended.

Considering that the quality of assessment scales and the rigor of data collection process are fundamental for any epidemiological studies (Damásio & Borsa, 2017; Reichenheim & Moraes, 2007; Streiner et al., 2015), the cross-cultural adaptation of BDI-2 for Brazil pursued this idea, especially because a cultural and economic context such as Brazil needs tools designed to attend the necessities of its infant and early childhood population. Unfortunately, it is common in Brazil, as in many other countries, to use scales from different countries and cultures that are not adapted and validated in a meticulous process of cross-cultural adaptation (Albuquerque & Cunha, 2020; Coster & Mancini, 2015). The availability of child development assessment tools, theoretically consistent and culturally appropriate, can contribute to improvement of the diagnostic procedures and the monitoring of clinical intervention results. Also, those tools can support cross-sectional and longitudinal studies, focused on offering information to support public policies and services for health and child development. Finally, in order to provide integrated monitoring of child

health and development and preventive interventions for infant and child population, it is important more psychometric studies focused on the adaption of established instruments, such as the Battelle Developmental Inventory, 2nd Edition.

Contributors

K. A. ALBUQUERQUE and A. C. B. CUNHA contributed to the conception and design, data analysis, interpretation, writing, review, and approval of the final version of the article. M. D. BERKOVITS contributed to the data analysis, interpretation, writing, review and approval of the final version.

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