Cross-cultural Adaptation of the Childhood Executive Functions Battery (CEF-B) to Brazilian Portuguese

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ABSTRACT

This study aimed to describe the processes of translation and cross-cultural adaptation to Brazilian Portuguese of the Childhood Executive Functions Battery (CEF-B), designed to evaluate executive functions in children and adolescents from 6 to 16 years of age. Six steps were carried out to ensure the quality of the processes: 1. instrument translation into the new language; 2. synthesis of the translated versions; 3. evaluation of the synthesized version by experts; 4. evaluation by the target population; 5. back-translation and 6. pilot study. We sought to ensure the translation and adaptation properties of the CEF-B in terms of semantic, idiomatic, experiential and cultural equivalence between the instructions in the original language and the target language. Results showed preliminary evidence of cultural adequacy and a satisfactory comprehension of the instrument instructions by the target population.
Keywords: neuropsychological assessment; executive functions; childhood; adolescence; Childhood Executive Functions Battery.

RESUMO – Adaptação Transcultural do Protocolo FEC – Funções Executivas em Crianças para o Português Brasileiro

Este estudo objetiva descrever os procedimentos de tradução e adaptação transcultural para o português brasileiro do Protocolo Funções Executivas em Crianças (FEC), voltado para a avaliação das funções executivas de crianças e adolescentes de 6 a 16 anos. Para garantir a qualidade do processo, foram realizadas seis etapas: 1. tradução do instrumento do idioma de origem para o idioma-alvo; 2. síntese das versões traduzidas; 3. avaliação por *experts*; 4. avaliação pelo público-alvo; 5. tradução reversa e 6. estudo piloto. Buscou-se assegurar as propriedades da tradução e adaptação do protocolo FEC, em termos de equivalência semântica, idiomática, experiencial e cultural entre as instruções no idioma original e no idioma-alvo. Os resultados apontaram evidências iniciais de adequação cultural e boa compreensão das instruções do instrumento pelo público-alvo.
Palavras-chave: avaliação neuropsicológica; funções executivas; infância; adolescência; protocolo FEC.

RESUMEN – Adaptación Transcultural del Protocolo FEN – Funciones Ejecutivas en Niños para el Portugués Brasileño

Este estudio objetiva describir los procedimientos de traducción y adaptación transcultural del protocolo Funciones Ejecutivas en Niños (FEN) para el portugués brasileño, dirigido a la evaluación de las funciones ejecutivas de los niños y adolescentes de 6 a 16 años. Para garantizar la calidad del proceso, se realizaron 6 etapas: 1. traducción del instrumento del idioma de origen al idioma de destino; 2. síntesis de las versiones traducidas; 3. evaluación por expertos; 4. evaluación por el público objetivo; 5. traducción inversa y 6. estudio piloto. Se buscó garantizar las propiedades de la traducción y adaptación del protocolo FEN, en términos de equivalencia semántica, idiomática, experiencial y cultural entre las instrucciones en el idioma original y en el idioma de destino. Los resultados apuntaron evidencias iniciales de adecuación cultural y buena comprensión de las instrucciones del instrumento por el público objetivo.
Palabras clave: evaluación neuropsicológica; funciones ejecutivas; niños; adolescentes; protocolo FEN.

Executive functions (EF) are among the most studied and debated cognitive processes in the current neuropsychological literature. These high-level processes are particularly important in dealing with new situations or circumstances that require adjustment, adaptation or flexibility of behavior (Luria, 1966). Currently, there is a relative consensus in literature that such skills constitute a multidimensional construct (e.g, Diamond, 2013; Friedman & Miyake, 2017; Miyake et al., 2000). Inhibition (inhibitory control and interference), working memory

(WM) and cognitive flexibility are considered the main and most basic components of EF, despite the great variability of processes classified as executive. However, there is no consensus on how they contribute, either alone or in combination, to the solution of tasks (Dias et al., 2015).

In children as in adults, EF are essential for the orientation and regulation of intellectual, emotional and social abilities (Diamond, 2013). Especially in children, these abilities have been pointed out as predictors of academic success, being considered more significant than the intelligence quotient (IQ), especially during the first years of school (Follmer, 2017). Given the recognition of the importance of EF for quality of life at all stages of development, research on this topic has become central in neuropsychological assessment, especially in the clinical context (Zelazo, 2015). However, the great variety in theories and methods for the assessment of EF ends up generating an enormous amount of data but also controversies about the evidences found (Malloy-Diniz, Fuentes, Mattos, & Abreu, 2018).

Specifically, in the case of children and adolescents, neuropsychological assessment makes it possible to identify early changes in cognitive and behavioral development, which may be associated with executive symptoms. It should be noted that a large number of neurodevelopmental and psychiatric disorders present executive changes as central symptoms (Dajani, Llabre, Nebel, Mostofsky, & Uddin, 2016). Thus, the identification of these changes during childhood is essential to provide information not only for diagnostic hypotheses, but also for structuring of interventions. In addition to clinical elements (interview), appropriate and reliable psychometric tests (performance-based tests and more ecological methods such as rating measures) specially designed for the pediatric population are needed. For that purpose, these instruments must consider developmental, contextual, and cultural aspects in their theoretical construction and normative data.

Regarding their developmental aspects, EF reach maturity later in comparison to other cognitive functions. Literature indicates that the progression of the development of these functions does not occur in a linear way, but by growth spurts of development. The explanation for this phenomenon lies in its multidimensional nature and the different developmental trajectories of executive skills (Anderson, 2002). Given the relevance of these factors, an adequate tool for the evaluation of EF in the pediatric population should consider the specificities and trajectories of their ontogenetic development. This implies that the material of the test must be adapted to the level of development of the child and must allow the possibility of mediation during the execution of the task. The use of mediational strategies is especially important in case of errors in the execution of the task. The level of mediation (quantity and quality) required to perform the task allows a better understanding of the level of development (acquired/undergoing/unacquired) of the evaluated function

and help estimate the presence of potential deficits in children (Tzuriel, 2001).

As for contextual factors, the influence of historical, social, and cultural factors on the emergence of EF in children has been increasingly recognized, given the extended neurobiological maturation of fronto-subcortical networks and the vulnerability of executive development (Farah, 2017; Lawson, Hook, & Farah, 2017). Different variables such as the mother's schooling, parent's profession, income, socioeconomic level, or the kinds of play in different childhoods, are considered as key factors that influence on the development of EF, especially WM, selective attention and flexibility (Noble et al., 2015; Ursache & Noble, 2016). These aspects suggest that the development of EF assessment tools should consider the cultural aspects of the country and region in which they will be used (Bellaj, Salhi, Le Gall, & Roy, 2015; Er-Rafiqi, Roukoz, Le Gall, & Roy, 2017). In Brazil, this aspect is particularly important because it is a country with a remarkable cultural variability and socioeconomic inequality (Piccolo, Arteche, Fonseca, Grassi-Oliveira, & Salles, 2016).

Despite Brazilian efforts in producing and adapting tests that evaluate EF in infancy, there is still a noticeable concern about the standardization and validation of the available instruments. It is also worth noting that there is a shortage of test batteries based on specific theoretical models. These limitations hamper the broadening of the knowledge on the typical development of these functions in Brazilian context, as well as the semiology appraisal of executive disorders, whether due to neurodevelopmental disorders or contexts of vulnerability and social risk (Barros & Hazin, 2013).

In order to contribute to overcome the aforementioned evaluation methodological challenges, this study aims to provide to Brazilian researchers and professionals a protocol of performance-based tests specially developed for the assessment of EF in school-aged children and adolescents: the Childhood Executive Functions Battery (CEF-B). More specifically, this study aimed to translate and adapt the CEF-B to Brazilian Portuguese. It should be noted that these processes did not only seek equivalence with the original instrument, but also considered the cultural differences and their implications for the development and understanding of EF.

The Childhood Executive Functions Battery

The theoretical-methodological pillars of the CEF-B were, at a first moment, the object of a multicenter study carried out in France. The development of the protocol arose from the interest of French researchers in composing an instrument for evaluating executive functioning in children and adolescents, given the scarcity of instruments adapted and available for the French pediatric population (Roy, 2015). This battery is theoretically based on a child-centered EF model (Diamond, 2013) and consists of a set of 12 tests for the neuropsychological assessment

of EF, aimed at children and adolescents between six and 16 years. The main evaluated processes correspond to the three basic executive components: inhibition, flexibility, WM in addition to a more complex component – planning (Diamond, 2013).

The CEF-B is composed of existing tests and new experimental tasks for children or adults that have been modified or expanded to better serve the purpose of evaluating the pediatric population and also to better understand the specificity of EF roles in tasks (see Annex A – accessible at *https://github.com/amandaguerra3/ANNEX-A-Brief-description-of-the-tests-and-scales-that-compose-the-CEF-B/*

blob/master/ANNEX%20A.pdf – for a brief description of the tests or Guerra, 2016 for the full description). The total test duration is of approximately two hours, knowing that, naturally, this time varies according to the child's age, clinical condition, and culture. The order of application of the tests that integrate the protocol was established in a systematic and pseudo-random manner, alternating the executive skills investigated and their verbal/non-verbal nature. The purpose of this order is to verify the influence of basic processes on executive performance, as well as to have usable tests in case of communication, visuospatial or praxical disorders (Roy, 2015).
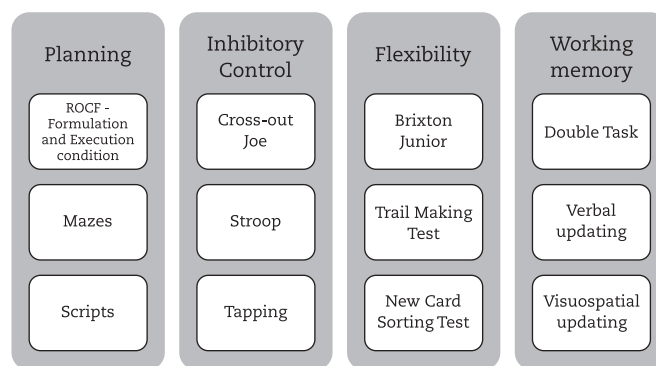

Figure 1. Overview of the CEF-B

Given that the assessment of EF must be based on several indicators and different evaluative sources including performance-based and rating measures (Toplak, West, & Stanovich, 2013), the protocol also includes a behavioral rating inventory of EF for parents and teachers - BRIEF. Therefore, it is possible to associate task results with information about the daily life of the child or adolescent (Roy, 2015). This inventory has already been adapted to Brazil (Carim, Miranda, & Bueno, 2012) and therefore will not be the object of investigation in this study. In addition to the 12 EF performance-based tests, the protocol has scales of interest and success of the child in each test, which are answered in self- and hetero-evaluation.

The CEF-B standardization and validation process in France is expected to be finalized in 2019 and is being conducted with one thousand healthy children aged six to 16 years and more than 200 patients from 15 different clinical conditions. In addition to the French partnerships, the project currently has international collaborations established with Tunisia, Brazil, Morocco, Lebanon, Ecuador and Switzerland which provides the instrument with robustness in terms of cross-cultural validity. Preliminary evidence of validity of the French version has been published regarding the Stroop test (Roy et al., 2018), BRIEF (Fournet et al., 2014), and studies with

different clinical groups, such as neurofibromatosis type 1 – NF1 (Remigereau et al., 2018; Roy et al., 2014, 2010), parietal temporal and frontal epilepsy (Campiglia et al., 2014; Charbonnier, Roy, Seegmuller, Gautier, & Le Gall, 2011), traumatic brain injury (Chevignard et al., 2017) and brain tumors (Roche et al., 2018). These initial data indicate a good sensitivity of the battery for the evaluation of EF in pediatric populations, which justifies the proposal of its adaptation to the Brazilian context (Good developmental validity for the Stroop test – $F(5, 108) = 10.42$, $p < .001$; Good clinical sensitivity of tasks with significant statistical differences between clinical and control groups for ROCF – F $1,69 = 6.889$, $p = .011$ – for the NF1 group and Zscore = 2,89 for frontal epilepsy case; NCST – $p \leq .001$ for the NF1 group; Brixton – Zscore= -4,03 for frontal epilepsy case, $p \leq .001$ for the NF1 group).

Method and results

Procedures and Participants

The translation and adaptation study was divided in six steps as proposed by Borsa, Damásio, & Bandeira (2012): 1. instrument translation into the new language; 2. synthesis of the translated versions; 3. evaluation of the synthesized version by experts; 4. evaluation by the target population; 5. back-translation; 6. pilot study. The

study complied with all the ethical principles required by Resolution 466/2012 of the National Health Council, being approved by the Research Ethics Committee of the Federal University of Rio Grande do Norte under the code CAAE 48383715.1.0000.5537.

An overview of the participants and procedures performed in each step is presented in the following flowchart (Figure 2). We opted to present a detailed description of the method followed by the results of each step to improve reading comprehension.
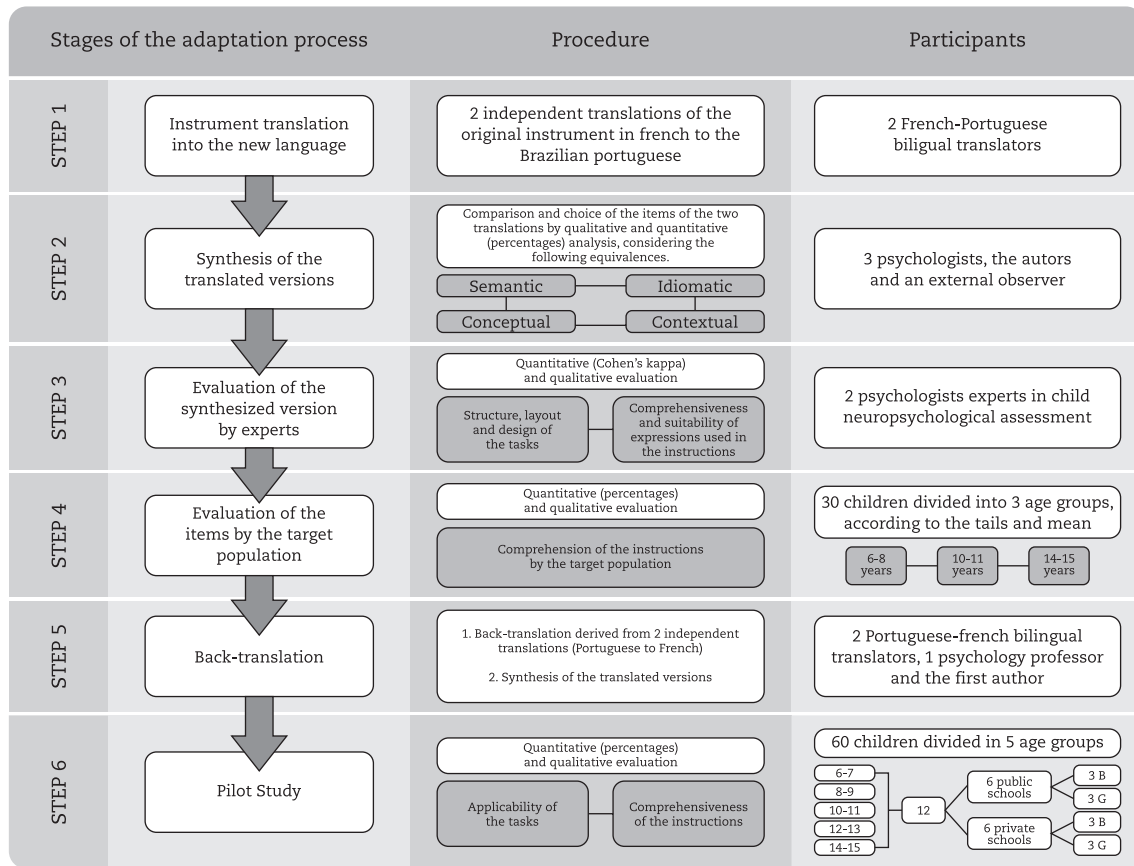

Figure 2. Overview of Summarized Method

Note. B=Boys; G=Girls

Instrument translation into the new language

For the translation of the CEF-B, two Portuguese-French bilingual translators fluent in the original language of the instrument and native in the target-language were involved: 1. a Brazilian psychologist fluent in French and 2. a Brazilian professor with a doctorate in French language and literature, fluent in French. The objectives of the study were explained only to translator one (psychologist). This methodological decision is justified by the literature, since the adaptation provided by the first translator tends to be more scientifically similar to the instrument, providing a greater semantic equivalence (Beaton, Bombardier, Guillemin & Ferraz, 2000). On the other hand, the adaptation from the second translator would be less likely to deviate in terms of the meaning of the original items.

Since the second translator is less influenced by the academic objective of the translation, he/she offers a version that better reflects the language used by the target population (Beaton, Bombardier, Guillemin, & Ferraz, 2000).

This step ended with two translated versions of the instrument (T1 and T2), rich in details and with a good semantic equivalence to the original instrument, showing, however, few discrepancies between them. The initial evaluation of the semantic equivalence of the two translations was carried out qualitatively by the main author of this article, who is fluent in both languages. The differences do not change the meaning of the instructions, but represent different translation styles (see table 1 for an example or Guerra, 2016 for the full description). This result agrees with what Beaton et al.

(2000) recommended on obtaining 2 versions with distinct nuances of the language for which the instrument is intended, allowing a greater cultural adequacy of the adaptation process.

Table 1
Comparison Between the Original French Version, the Two Translations (T1 and T2) and the Synthesis

Original French Version	T1	T2	Synthesis of the translated versions
Je vais te demander un travail qui demande que tu fasses bien attention. Je te présente Joe. Ici, tu vois, il y a d'autres petits personnages. Tu dois essayer de trouver si Joe se cache parmi ces personnages et si tu le trouves, il faut le barrer avec ce crayon ! Tu as compris?	Eu vou te pedir um trabalho que necessita bastante da sua atenção. Este é o Joe. Aqui, veja, há outros personagens Você deverá tentar descobrir se Joe se encontra entre esses personagens e, se você o encontrar, deverá marcá-lo com este lápis! Você compreendeu?	Eu vou te pedir um trabalho que necessita bastante da sua atenção. Eu te apresento Joe. Aqui, veja, há outros personagens. Você deverá tentar descobrir se Joe se encontra entre esses personagens e, se você o encontrar, deverá marca-lo com esse lápis! Você entendeu?	Agora você vai fazer uma tarefa que precisa você precisa prestar bastante atenção. Este é o Joe*. Aqui, veja, há outros personagens. Você deve descobrir se Joe está entre esses personagens e, se você o encontrar, deverá marcá-lo com este lápis! Você entendeu?

Note. *The change in the name of the character "Joe" was not initially adapted in the synthesis stage, because the committee did not consider, from their expertise in neuropsychological evaluation, that this name would compromise the understanding of the instructions. However, in the stage of evaluation of the synthesis by experts, changing the name "Joe" to a Brazilian name (i.e., João) was suggested and eventually incorporated in stage 3

Synthesis of the translated versions

The translated versions were analyzed by three psychologists, experts in child neuropsychological assessment, the auteurs and as well by an external observed, aiming to obtain a unique synthetized version. During this phase, it is relatively common to find two possible sources of complications: 1. complex translations that may hamper the understanding of the target population or 2. over-simplistic translations that underestimate the content of the item (Borsa et al., 2012). To better adapt the translations into Brazilian Portuguese, the two versions were compared and evaluated considering their semantic, idiomatic, conceptual, linguistic and contextual discrepancies. Both translations were compared to the original version in order to identify discrepancies and similarities between them.

In this step an evaluation sheet was prepared containing the original version of the instructions for each test and their respective translations (T1 and T2). The sheet presented evaluation elements for semantic, idiomatic, conceptual and contextual equivalence aspects, as presented in Table 2. In addition to these elements, the committee (judges and authors) was invited to choose the best adapted version, as well as to make suggestions to improve the instructions for the target population.

Table 2
Evaluation Elements for Each Type of Equivalence

Semantic equivalence	Idiomatic equivalence	Contextual equivalence	Conceptual equivalence
1. Adequate (words have the same meaning)	1. Yes. Items were adapted to an equivalent expression.	1. Yes. Applicable in the new culture	1. Yes. The expression assesses the same aspect in both cultures.
2. Partially adequate (if the item has more than one meaning)	2. No. Translation does not hold the same cultural significance of the item.	2. No. The item cannot be applied. Suggestion:	2. No. The item does not assess the same aspect. Suggestion:
3. Inadequate (grammatical errors in the translation)	3. Does not apply. Item is easily translated.		

All three experts and the authors deemed one of the versions (T2) as the overall best adaptation (85,71% of the instructions). Only two items (14,2%) were retrieved from the other translation (T1). In terms of semantic equivalence, the experts judged that the words used in both translations had the same meaning and the protocol items were evaluated as adequate. The evaluation was carried out qualitatively on the basis of the

evaluators' knowledge in both languages and their expertise in child neuropsychology. A few changes were made in order to ensure a better adaptation of the instrument to Brazilian children (see table 1 for an example or Guerra, 2016 for the full description). Experts also considered that the translated items were replaced by equivalent expressions, with a satisfactory idiomatic equivalence. Regarding experiential and conceptual equivalences, experts considered that the tasks and instructions proposed by the original instrument were pertinent to Brazilian cultural context.

Evaluation of the synthesized version by experts

In the next step, an evaluation by experts was conducted. Two psychologists experts in child neuropsychological assessment from the south and southeast regions of Brazil participated, who evaluated structure, layout and design of the tasks, as well as comprehensiveness and suitability of expressions present in the instructions. The experts also assessed whether the terms or expressions could be generalized to different contexts and populations (i.e. different regions of the same country) and whether the expressions were suitable for the audience for which the instrument is designed. The experts received an instruction letter, the manual and the tasks

of the protocol, as well as an evaluation sheet developed specifically for this step, which included the objective of the study, a brief description of the instrument and information on the population involved. Elements of layout, design and instructions for all tasks to be evaluated were presented on the sheet. Layout elements were evaluated globally and the task instructions were evaluated individually. The experts answered the sheet in a quantitative sense, through three-point Likert scale (adequate, partially adequate and inadequate) and in a qualitative sense, through comments and suggestions for all the instructions of the protocol and the layout aspects.

The agreement between experts regarding all the tasks of the CEF-B was assessed by Cohen's Kappa (Landis & Koch, 1977), which indicated substantial agreement (0.70). The coefficient was calculated globally considering all experts answers. Both experts considered all the aspects of the layout, structure, and design of the protocol as adequate. Most of the instructions were evaluated as adequate (78,57%) and none was considered as inadequate. Only three items (21,42%) were considered as partially adequate by the experts and were modified in order to guarantee the protocol's adequacy for the child population (see table 3 for an example or Guerra 2016 for the full description).

Table 3
Example of Modifications in the ROCF Instructions (Execution Condition) After Experts Evaluation

	Partially appropriate Item	Justifications of the experts	Item after modifications
ROCF - Execution condition	Aqui tem mais um desenho. Você vai copiá-lo nesta folha. Tente fazer o melhor que puder. Preste atenção nas proporções e, principalmente procure não esquecer nada. Não tenha pressa! Quando você achar que copiou tudo, você me diz. Comece com este lápis.	E1: Proporções – termo difícil para crianças menores de 11 anos... talvez explicar melhor com exemplo. E2: Proporções pode ser difícil para entendimento de crianças pequenas. Colocar entre parênteses IGUALDADE para o examinador explicar melhor.	Aqui tem mais um desenho. Você vai copiá-lo nesta folha. Tente fazer o melhor que puder. Preste atenção aos tamanhos e, principalmente procure não esquecer nada. Não tenha pressa! Quando você achar que copiou tudo, você me diz. Comece com este lápis.

Evaluation of the intelligibility of the items by the target population

After the evaluation by experts, a complementary assessment of the understanding, clarity and suitability of the instructions by the target audience was carried out. To that end, only the instructions and training phase of each test were applied to 30 children and adolescents aged six to 15 years from two public schools. The participants were separated in three groups of 10 subjects, according to the tails and mean point of the protocol age distribution, as follows: Group 1: children between six and eight years old; Group 2: children between 10 and 11 years old; Group 3: adolescents between 14 and 15 years old. At this step, the comprehension of the instructions by the target

population was verified. The results were categorized into dichotomous variables (comprehends vs does not comprehend) and were analyzed based on the percentages of comprehension of each instruction. A broad understanding of the protocol instructions was observed in all age groups. Full comprehension was identified in eight of the 12 instructions of the tests and in both scales, namely: Mazes, Stroop; Tapping rate; Rey Osterrieth Figure (ROF) - Execution condition; Trail Making Test (TMT), Double Task; New Card Sorting Test (NCST); Cross-out Joe; Brixton Junior; and Interest and Success scales.

Difficulties in comprehending and performing the training phase were identified in four (updating tests – visuospatial and verbal –, Stroop and Scripts tests) of the

12 tests, exclusively in the six and seven-year-old children group (Group 1). The updating tests instructions were not fully understood by Group 1, with 60% and 40% of comprehension for verbal and visuospatial tests, respectively. It is important to point out that comprehension difficulties were related to the acquisition of the concept of "last" position (in the case of said tests, the notion of the "last three or four"), especially by children aged six. Operational problems were also identified in the Stroop and Script tests, again specifically in children with six and seven years old. Because they are verbal tests that require the prior acquisition of reading skills, five children (71,4%) aged six and seven years old who had not yet consolidated this process did not complete the training phase.

Preliminary studies with the CEF-B protocol were carried out with children aged between seven and 12 years old. The six-year-old age group is being added to the French standardization process after discussions about the pertinence of some tests for that particular age, namely: Stroop, Scripts, TMT and updating tests (verbal and visuospatial). Such consideration is justified by potential reading difficulties and, in the particular case of updating tests (verbal and visuospatial), by possible issues in comprehending the task.

After discussing with the authors of the protocol about the pertinence of using updating tests in this age group, an agreement was reached that previous evaluation was needed in order to guarantee that children understand the concept of "last three". To this end, an order identification task was elaborated and incorporated into the pilot study for the updating tests, exclusively for Group 1. In addition, tests requiring automated reading (Stroop and Scripts) or alphabet sequencing (TMT) were not applied to children who did not have these skills consolidated as observed in the training stage.

Back-translation

The back-translation derived from two independent translations of the final version in Portuguese to French. Translations were carried out by two professionals fluent in the original language of the final document (Portuguese) and native in the target language (French). Subsequently, the translated versions were synthetized, in which participated a psychology professor and the first author of this work, both fluent in the two idioms. At the end of the process, the back-translation was sent to the CEF-B original authors, so they could evaluate the translation.

The experts considered that the translated items were replaced by equivalent expressions in French in both versions. However, they opted, in most cases, for the use of items of one of the translated versions, adding only a few excerpts from the other version in order to make the synthesis more authentic to the Portuguese version. Small changes were made to the French translation in order to further adequate it to the original document in Portuguese. The back-translation was sent to the authors of the protocol, who considered it consistent in terms of conceptual equivalence and no modification was needed.

Pilot Study

The pilot study was performed after the protocol was discussed and approved by its authors. This step counted on the participation of 60 children and adolescents aging between six and 15 years, separated in five groups, as follows: Group 1 – children between six and seven years old; Group 2- children between eight and nine years old; Group 3 – children between 10 and 11 years old; Group 4 – adolescents between 12 and 13 years old; Group 5 – adolescents between 14 and 15 years old. Each age group was composed by 12 children, six belonging to public schools and the other six belonging to a private school. Furthermore, these groups were subdivided by gender, with three females and three males each.

The pilot study was carried out in four public schools and one private school from the Natal and Parnamirim (State of Rio Grande do Norte – Northeast of Brazil) educational systems. Its inclusion criteria were: 1. signing of the Informed Consent Form by parents and/or legal guardians; 2. to be properly registered in public or private schools from the educational system of Natal and Parnamirim; 3. no register of past school failure; 4. IQ score inside the normal variation (80 to 119 points of IQ); 5. no complaints of neurodevelopmental alterations or uncorrected sensory disabilities. A total of 68 children were subjected to the application of the Vocabulary and Matrix Reasoning subtests from the Wechsler Abbreviated Scale of Intelligence (WASI). Eight of these participants scored a total IQ below 80 and, therefore, were excluded from the sample.

Discussion

The results of the pilot study showed that all the tests and scales of the CEF-B have clear instructions for all age groups of the evaluated sample and are suitable for use in the new cultural context. This result suggests that the translation and adaptation steps were sufficient for the cross-cultural adaptation of the instrument instructions. Similarly, information contained in the stimuli presented to children was clear and adequate for most tests. However, in the Scripts test, difficulties were observed by different age groups in understanding the stimuli presented. This result indicates that the previous translation and adaptation stages were insufficient for the cross-cultural adaptation of the task stimuli, requiring an additional adaptation study and a second pilot study.

The pilot study showed that the two scales and five of the tests (Brixton Junior, NCST, Tapping, Double Task and the execution condition of ROCF) are suitable for all ages. The applicability difficulties of the seven

remaining tests were evidenced exclusively in children of Group 1 (six and seven years), especially in children with six years old. Two types of difficulties were identified in the accomplishment of the tasks by this group: 1. the underlying concepts and abilities necessary for the execution of the tasks seem to not have been developed yet by the age of six; and 2. the level of difficulty and demotivation/frustration in executing the task. Such difficulties can be explained by the fact that the CEF-B was elaborated to a wide age range, considering different stages of development.

Regarding type 1 difficulties (acquisition of underlying concepts and abilities), as evidenced in the evaluation by the target-population step, children in Group 1 (six to seven years old) presented difficulties in executing verbal tasks that require the prior acquisition of reading skills, namely: Stroop, Scripts and TMT. In this age group, the acquisition of these skills is still in active development.

Still regarding type 1 difficulties, children of Group 1 also presented difficulties in performing the updating Tasks (verbal and visuospatial). Therefore, in the pilot study, a previous task was incorporated after the baseline of the Visuospatial updating test in order to evaluate the understanding of the concept "last three and four" by younger children. To that end, five colored pencils were arranged on the table (side by side) and the examiner asked the subject to count how many pencils were on the table. The subject was then asked to point at the first and the last pencil he/she counted. Subsequently, the subject should point at the last three and four pencils he/she counted. Six out of seven children that were part of Group 1 pointed at the three middle pencils (neglecting the extremities) as the last three, and the first four pencils as the last four. Only one child pointed the last three and four pencils correctly, but had difficulty performing the training phase, and failed all attempts. It should be noted that even after explaining the concept, the children struggled to perform the 'Visuospatial Updating Task' training phase. Studies point out that in addition to WM, updating tasks require considerable information processing flexibility and a gradual alternation of attention, for example, when discarding some items while new ones are being registered (Salmon et al., 1996). In order to remember the last items in a sequence in which the ending is not predictable, the child needs to consider all other items, knowing the first and last item and respecting the given sequence. To do so, children must perform opposing actions simultaneously, mentally doing and undoing the same action. However, such skills are still in dynamic development in six-year-old children.

In addition, studies show that cognitive flexibility develops gradually during childhood and experiences a growth spurt around age 12 (Anderson, 2002). WM and inhibitory control seem to develop before flexibility and are underlying components of the development of flexible behaviors (Best & Miller, 2010). Besides difficulties

in reversibility of thought, the development of WM in six-year-old children is still insufficient for executing updating tasks, since the differentiate development of underlying mechanisms of executing retaining tasks, such as sequencing and keeping information in the WM (Diamond, 2002), significantly develops only between seven and 13 years old (Lázaro & Ostrosky-Shejet, 2012). Thus, updating tasks seem to be inappropriate for six-year-old children, since the necessary underlying concepts and abilities are not sufficiently developed yet to perform tasks in this age group.

Regarding type 2 applicability difficulties (level of difficulty and demotivation/frustration in executing the task), Group 1 children had difficulties in the Mazes and Cross-out Joe tasks. On the other hand, adolescents considered Tapping an easy and demotivating task. The Mazes test was considered a very difficult task by children in Group 1, who constantly complained about the quantity and complexity of the labyrinths presented even at the beginning of the task. The average number of labyrinths performed within the time limit by children in this group was five out of eight labyrinths. These results indicate the need to establish interruption criteria for this task that take into consideration the level of development of the planning executive component. The Cross-out Joe test was pointed out by children and adolescents of different ages as one of the least pleasant and most demotivating activities because of its length. The activity was mostly disapproved by children between six and seven years old. During the test, children frequently presented facial expressions of disapproval and made negative comments. It should also be noted that two six-year-old children refused to perform part B of the task and one of them gave up during the execution of the task. However, it is important to note that the test was built in an effort to represent tasks of the child's daily life. It was designed to represent long and monotonous tasks that require sustained attention engagement (e.g. school activities). Therefore, it is expected that children in general will find the task less motivating and that children with six years old will have greater difficulties in engaging in the task.

Tapping was pointed out as the easiest test in the protocol by adolescents and children from nine years on, being considered by many to be demotivating. Thus, future analyzes should investigate the presence of a possible 'ceiling effect' and should be considered in the standardization of the instrument. It should be noted that inhibition tasks have shown different sensitivities according to the stage of development, some of which are sensitive to conceptual gains in early childhood and others to the refinement of cognitive abilities in late childhood and adolescence (Best & Miller, 2010).

The literature shows that performance in inhibition tasks of the Go/No-Go type reaches a ceiling effect in children between nine and 11 years old. More precisely,

a significant decrease in impulsive errors (commissions) and absence of response (omissions) was identified in the comparison between groups of children aged six to eight years old and groups of children between nine and 12 years old, with little to no variation in the age group of adolescents between 13 and 15 years old. On the other hand, the performance in other classic inhibition tests, such as the Stroop Test, shows a continuous growth in reaction time and precision measures up to 15 years old (Huizinga et al., 2006). However, when dealing with changes in the development of inhibitory control in subjects with clinical conditions, tasks of the Go/No-Go type are pointed out as a sensitive measure, especially in Attention Deficit/ Hyperactivity Disorder (Brocki & Bohlin, 2004).

The tasks pointed out in this study as inappropriate for children in Group 1, especially those with six years of age, due to the underdevelopment of underlying skills, were excluded for this age group in undergoing normative studies. In addition, the tasks considered inappropriate due to applicability difficulties for this age group may incorporate start and stop point, after normative studies and analysis based on the item response theory have been carried out. On the other hand, some tasks pointed out as easy may be conducted up to the age limit established by possible ceiling effects.

Pilot study 2: Scripts

In order to avoid any kind of linguistic bias, a group of five neuropsychological assessment experts suggested changes in actions that were not easily comprehensible to the children. Subsequently, the changes were translated into French and presented to the task creators, who considered the suggestions adequate (Table 4). A second pilot study was carried out to assess whether the task is, at last, ready to be used in the Brazilian context (Borsa et al., 2012).

The second pilot study was carried out with 30 children and 80 university students, aged between 20 and 25 years, in order to validate the linguistic adaptations. The pilot study with university students was necessary in order to contemplate the possibility of more than one correct script sequence due to possible cultural differences in the execution of the task. The data were analyzed and discussed in agreement with French data. This allowed for in-depth reflection on the responses given by Brazilian children and on the problematic of cultural differences. After the second pilot study, the adaptation of the task to the Brazilian context was deemed good, which enabled the realization of validation and standardization studies of the protocol.

Table 4
Changes in the Scripts Test for the Second Pilot Study

| Name of the Script | actions in the first pilot study | | changes in the second study pilot | |
	original in Portuguese	action in English*	original in Portuguese	action in English*
Take a shower	se lavar	wash yourself	tirar o sabão	rinse yourself
Pack the school bag	ver o horário	check time	olhar o horário das aulas	check class time table
	guardar a mochila para o dia seguinte	put the bag away for the next day	levar a mochila para a escola	take the bag to school
Do the shopping	colocar as compras no carro	put the groceries in the car	colocar as comprar no automóvel	put the groceries in the vehicle

*provided only for the English version of this article

Final considerations

The process of cross-cultural adaptation of the CEF-B to the Brazilian Portuguese allowed verifying that the instructions were well-comprehended by children and adolescents. Additionally, the tests and scales which compose the protocol had good applicability. The continuity of this research is an ongoing study in order to guarantee the availability of validity and reliability psychometric parameters, as well as normative data that consider the variables age, schooling and the particularities of the different regions of Brazil. We expect that the availability of the CEF-B for professionals working with neuropsychological assessment in Brazil will help minimize the shortage of instruments specifically developed for children and adolescents, especially those which consider developmental, cultural and motivational aspects in their proposition.

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Contribuições dos autores

Declaramos que todos os autores participaram da elaboração do manuscrito. Especificamente, os autores Amanda Guerra, Izabel Hazin, Arnaud Roy e Didier Le Gall participaram da redação inicial do estudo – conceitualização, investigação, visualização, os autores Amanda Guerra, Izabel Hazin e Arnaud Roy participaram da análise dos dados, e os autores Amanda Guerra, Yasmin Guerra, Isadora Silvestre, Marinna Rezende, Didier Le Gall, Arnaud Roy e Izabel Hazin participaram da redação final do trabalho – revisão e edição.

Disponibilidade dos dados e materiais

Todos os dados e sintaxes gerados e analisados durante esta pesquisa serão tratados com total sigilo devido às exigências do Comitê de Ética em Pesquisa em Seres Humanos. Porém, o conjunto de dados e sintaxes que apoiam as conclusões deste artigo estão disponíveis mediante razoável solicitação ao autor principal do estudo.

Conflito de interesses

Os autores declaram que não há conflitos de interesses.

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