The Spanish Journal of Psychology
2008, Vol. 11, No. 2, 678-688


ISSN 1138-7416

# Brazilian Version of the Protocole Montréal d'Évaluation de la Communication (Protocole MEC): Normative and Reliability Data

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The lack of standardized instruments to evaluate communication disorders related to the right hemisphere was verified. A new evaluation tool was developed: Protocole Montréal d'Évaluation de la Communication – Protocole MEC, adapted to Brazilian Portuguese – Bateria Montreal de Avaliação da Comunicação – Bateria MAC (Montreal Evaluation of Communication Battery). The purpose was to present stratified normative data by age and educational level, and to verify the reliability parameters of the MEC Battery. 300 individuals, between the ages of 19 and 75 years, and levels of formal education between 2 and 35 years, participated in this study. They were divided equally into six normative groups, according to three age categories (young adults, intermediary age, and seniors) and two educational levels (low and high). Two procedures were used to check reliability: Cronbach alpha and reliability between evaluators. Results were established at the 10th percentile, and an alert point per task for each normative group. Cronbach's alpha was, in general, between .70 and .90 and the average rate of agreement between evaluators varied from .62 to .94. Standards of age and education were established. The reliability of this instrument was verified. The psychometric legitimization of the MEC Battery will contribute to the diagnostic process for communicative disorders.
*Keywords: communication evaluation, Montreal, MEC, Brazil, psychometric properties*

Se verificó la falta de instrumentos estandarizados para evaluar los trastornos de comunicación relacionados con el hemisferio derecho. Se desarrolló una herramienta de evaluación nueva: el Protocole Montréal d'Évaluation de la Communication – ProtocoloMEC, adaptado al portugués brasileño – Bateria Montreal de Avaliação da Comunicação – Batería MAC (Batería de Evaluación de la Comunicación de Montreal). El objetivo fue presentar datos normativos estratificados por edad y nivel académico, y verificar los parámetros de fiabilidad de la batería MEC. 300 individuos, de edades entre los 19 y los 75 años y con 2 a 35 años de educación formal, participaron en este estudio. Se dividieron en seis grupos normativos, en función de tres categorías de edad (adultos jóvenes, edad mediana y mayores) y dos niveles educacionales (bajo y alto). Se emplearon dos procedimientos para confirmar la fiabilidad: alfa de Cronbach y fiabilidad inter-jueces. Se establecieron los resultados en el percentil 10 con un punto de alerta por tarea para cada grupo normativo. Los valores de alfa de Cronbach eran, en general, entre 0.70 y 0.90 y el grado de acuerdo entre los evaluadores variaba entre 0.62 y 0.94. Se establecieron normas de edad y educación. Se verificó la fiabilidad de este instrumento. La legitimación psicométrica de la Batería MEC contribuirá al proceso diagnóstico de los trastornos de comunicación.
*Palabras clave: evaluación de la comunicación, Montreal, MEC, Brasil, propiedades psicométricas*

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This work was funded by CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior).

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How to cite the authors of this article: Fonseca, R.P., Joanette, Y., Cote, H., Ska, B., Giroux, F. Fachel, J.M.G., Ferreira, G.D. and Parente, M.A.M.P.

The evaluation of communication disorders related to the right hemisphere is an emerging practice in the clinical context (Côté, Moix, & Giroux, 2004). It includes both non-standardized and standardized procedures. The first are mainly represented by informal questionnaires regarding the propriety of communicative behaviors, as well as by tasks selected for a specific case. The standardized procedures are divided into two classes: (a) functional communication scales, such as the ASHA FACS – American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (Fratalli, Thompson, Holland, Wohl, & Ferketic, 1995), which is intended to evaluate independence in communications; and (b) evaluation instruments for communication performance. Many of the standardized procedures for evaluation communicative performance examine the cognitive aspects, in general; only one confronts communication deficits present after injury to the right hemisphere – The Right Hemisphere Language Battery – RHLB (Bryan, 1995). Nonetheless, this instrument effects only a brief evaluation, around 20 minutes (Zanini, Bryan, De Luca, & Bava, 2005).

Traditional aphasia evaluation tests do not address sensitive stimuli to detect deficits in the processing of functional or pragmatic aspects of language (Bryan, 1995). This is because the population of individuals with right hemisphere injuries does not present typical language alterations, such as those presented by aphasic patients (Myers, 1999). However, the evaluation process for linguistic disorders in these individuals must include the use of instruments constructed specifically to examine communicative processing related to the right hemisphere. To meet this need, The Montreal Evaluation of Communication Battery - MEC Battery (Joanette, Ska, & Côté, 2004) was developed in French to investigate the depth of communicative abilities in individuals with right hemisphere injuries.

The MEC Battery is characterized as being a systematic evaluation instrument for individuals with right hemisphere injuries with communication deficits. Its purpose is to examine four communicative components: speech, pragmatic-inference, lexico-semantics, and prosody. This instrument was adapted to Brazilian Portuguese and given the name, Bateria Montreal de Avaliação da Comunicação – Bateria MAC (Fonseca, Parente, Côté, & Joanette, 2007). The validation of its content, construction and criteria can be found in Fonseca, Parente, Côté, Ska, and Joanette (2008).

Studies involving neuropsychological language instruments frequently exhibit a preoccupation with psychometric aspects (see Braun & Crépeau, 1997; Lezak, Howieson, & Loring, 2004; and Strauss, Sherman, & Spreen, 2006), as is the case with nomination tests (Tallberg, 2005). As far as evaluation instruments for cognitive and linguistic functions related to the right hemisphere, psychometric information appears in some manuals, such as the Mini Inventory of Right Brain Injury (Pimental & Kingsbury, 1989). Nonetheless, the first systematic studies with standards in reference to age and education were carried out with the MEC Battery (Côté et al., 2004) and with the Italian version of the Right Hemisphere Language Battery (Zanini et al., 2005). The reliability parameter was only studied in the first test.

Despite this search for psychometric criteria, in Latin America, neuropsychological tests have not yet been translated, and standards from other populations have been used (Ostrosky-Solís, Ardila, & Rosselli, 1999). This practice may invalidate the results found in the neuropsychological evaluation process.

From the relevance of these two factors – the large demand for specific communication evaluation instruments for individuals with right hemisphere injury, and the lack thereof for the Brazilian population – the present study has two objectives: (a) to present normative data stratified according to age and educational level, and (b) to verify the reliability parameter for the Brazilian version of the MEC Battery. Furthermore, it intends to contribute to the improvement of the evaluation of communication issues after right hemisphere injuries. Expectations for this study are as follows:

1) To develop differentiated norms in reference to age and educational level, replicating, thus, the two previous studies: (a) a preliminary study with a smaller sample, composed of 240 neurologically preserved Brazilians, and (b) the French study, using the original instrument (Côté et al., 2004; Fonseca et al., 2007).

2) To confirm the reliability of the Brazilian version of the instrument, once the original Canadian test has proved reliable (Côté et al., 2004) and adaptation of the *MEC Protocol* to Brazilian Portuguese has been completed (Fonseca et al., in press-b).

## Method

### *Participants*

The sample for this study was composed of 300 adults, aged 19 to 75 years (average age was 47.67 years; standard deviation of 17.00), with educational level varying from two to 35 years of formal education (average of 10.00 years; standard deviation of 6.01). Regarding distribution by gender, 231 women and 69 men participated. Although the gender variable was not controlled, it was noted that there was no difference among individuals of the female gender and the male gender in the variable dependent on communicative performance.

This general sample was stratified into six groups, according to the variables of age and academic level. First, it was divided into six groups with an age range of 10 years for each group. As no significant differences were observed among the subgroups, the sample was stratified into three groups. The division of samples into groups ranging 15 to 20 years in age for each standard groups is frequent in the

literature on standardization of neuropsychological evaluation instruments, as may be noted in studies such as the NEUROPSI (Ostrosky-Solís et al., 1999) and the Boston Diagnostic Aphasia Examination (Radanovic, Mansur, & Scaff, 2004). Thus, three groups were formed: (a) young adults (19 to 39 years), (b) adults of middle age (40 to 59 years), and (c) elderly adults (60 to 75 years), according to the distribution effected in the studies of the original instrument *MEC Protocol* (Joanette et al., 2004) and usually followed in psychological studies (Jin et al., 2003) and neuropsychological studies (Plumet, Gil, & Gaonac'h, 2005).

The variable of academic level divided the sample into two groups: (a) low academic level (2 to 7 years of formal education) and (b) high academic level (8 or more years of academic study). This distribution by two groups, or high and low educational levels, was effected in the study of the original instrument MEC Protocol (Joanette et al., 2004), as suggested by Plumet et al. (2005). The highest average of educational level in demographic studies of the Brazilian population corresponds to eight years of study, so this data was used as the cutting point for the division of the groups into low and high educational level (IBGE, 2003). In this way, six groups were formed: (a) young adults with low educational level; (b) young adults of high educational level; (c) middle-aged adults with low academic level; 4) middle-aged adults with high academic level; 5) elderly adults with low educational level; e, 6) elderly adults with high academic level. A breakdown of these six normative groups in respect to sample size and the descriptive data regarding age, academic level, and distribution by gender, is shown in Table 1. Calculation of the sample size was effected taking into account a significance level of 0.05, and a power of 90%. The average standard deviation found in a prior comparative study among age groups and various educational levels was used as a basis (Fonseca et al., 2007). This calculation requires a minimum sample size for each of the six groups of 38 participants.

### *Inclusion/Exclusion Criteria*

The subjects included were adults, Brazilian natives, without sensory impairments (uncorrected auditory and/or visual impairments), nor psychological or neurological disorders. Individuals that used psychotropic drugs or who had a prior or current history of alcohol abuse were excluded. Individuals with depression, as indicated by the Yesavage Depression Scale were not included in this sample (Yesavage, 1986; adapted to Brazilian Portuguese by Parente, 1990). Furthermore, adults with a score in the Mini Exame do Estado Mental – Mini-Mental (Mini-Exam of Mental State, Folstein, Folstein, & McHugh, 1975; version adapted for the local Brazilian population by Chaves and Izquierdo, 1992) below 21 (persons with two to four years of study), nor under 24 (participants with five or more years of studies) were not included. All of the inclusion and exclusion criteria were verified using a structured questionnaire of socio-cultural data and health aspects. Selection was carried out in universities, business centers, hospitals, and community centers, for convenience.

### *Instrument*

The Bateria Montreal de Avaliação da Comunicação – Bateria MAC (Fonseca et al., 2008) is the Brazilian version of the Montreal Evaluation of Communication Battery – MEC Battery, or Protocole Montréal d'Évaluation de la Communication – Protocole MEC (Joanette et al., 2004). Adaptation of the MEC Battery to Brazilian Portuguese was carried out based on three procedures: (a) translation (simple translation, back-translation and compared translation), (b) analysis of the psycholinguistic criteria by specialist judges, and (c) a pilot study. For more detailed information regarding the process of adapting this instrument, see Fonseca et al. (2007). It is composed for 14 tasks. The first is the questionnaire regarding awareness of the difficulties; as this is a subtest intended specifically for populations with neurological issues, it was not applied in this study. The other tasks are described below, in the order in which they were applied. Each item is scored as 0, 1, or 2, except the narrative discourse tasks, prosody, and semantic judgment, which were scored as 0 or 1 point.

*Conversation discourse.* This task evaluates discursive abilities in the context of a natural dialog. Two different themes are introduced by the examiner during a ten-minute conversation. Four themes are suggested: family, work, leisure, and current news. Various linguistic components are observed *a posteriori* using analysis of 17 pragmatic aspects (for example, indifference to jocular comments), lexico-

Table 1
*Characterization of the Six Subgroups in Relation to Age, Academic Level and Gender*

| Groups | Young adults | | Middle-aged adults | | Elderly adults | |
|---|---|---|---|---|---|---|
| | LE | HE | LE | HE | LE | HE |
| Age *M* (*SD*) | 29.80 (5.19) | 25.24 (5.27) | 49.02 (4.87) | 47.82 (5.01) | 67.18 (5.13) | 66.98 (4.86) |
| Educational level *M* (*SD*) | 5.36 (1.12) | 14.92 (3.07) | 4.90 (1.55) | 15.34 (4.93) | 4.62 (1.17) | 14.84 (5.14) |
| Gender (F/M) | 31/19 | 34/16 | 45/05 | 40/10 | 44/06 | 37/13 |

*Note*. $n$ = 50 in each group; LE =low educational level; HE = high educational level; F = female; M = male.

semantics (for example, word search), discursive (for example, imprecise exposure of ideas) and/or prosodic (for example, monotone voice).

Interpretation of metaphors. This subject explores the capacity to understand and explain the meaning of non-literal (figurative) sentences. It is composed of 20 metaphorical sentences, the first ten being new metaphors, or, unconventional metaphors not commonly used in Brazilian Portuguese (for example, *The bus is a turtle*). The last ten are idiomatic expressions (for example, *My dad gave me a little hand [translator note: means the same as in English, "a little help]"*). The person being evaluated is instructed to explain what the phrase means in their own words.

*Free lexical evocation.* This subtest assesses the ability to freely explore the lexico-semantic memory during the evocation of words without semantic or orthographic restriction. The examiner asks the test subject to say as many words as possible within two minutes and 30 seconds. The test is scored based on the scope of the vocabulary.

*Linguistic prosody comprehension.* This task assesses the capacity to perceive and identify patterns in linguistic intonation. It is based on four sentences with simple grammatical structure (subject, verb, object) with neutral content (for example, *Pedro drinks milk*). Each sentence was previously recorded on audio equipment with three different linguistic intonations (affirmative, interrogative and imperative) for a total of 12 phrases, in random order. The test subject is asked to identify the intonation responding verbally or pointing to one of the three options in corresponding visual images.

*Linguistic prosody repetition.* This subtest examines the ability to verbally reproduce linguistic intonations. It is formed of the same four phrasal stimuli as the previous task. The previously recorded stimuli are presented in random order. The test subject is asked to repeat each sentence with the same identified intonation.

*Narrative discourse.* This task presents three subtests that evaluate discursive abilities. The first subtest is partial re-telling, paragraph by paragraph. It assesses comprehension and evocation of complex linguistic information and indirectly examines inferential processing, since, for accurate comprehension of the narrated story, the subject must infer the protagonist's intentions. It is based on a narrative composed of five paragraphs that is read by the examiner, who asks the subject to re-tell the story in their own words, after each paragraph. Eighteen essential data and twenty nine present data are expected (essential and details). The second subtest is complete retelling, which evaluates the ability to synthesize and infer information. The same narrative is read by the examiner again, in its entirety. The test subject is instructed to retell the entire story in their own words. Thirteen principal data are expected. The third subtest examines comprehension of the story through twelve questions with short answers.

*Lexical evocation with orthographic criteria.* This task examines the exploration of lexico-semantic memory during the evocation of words with an orthographic criteria. The examiner asks the test subject to say the greatest number of words that begin with a specific letter *P* in two minutes.

*Emotional prosody comprehension.* This task evaluates the ability to perceive and identify emotional intonation patterns. It is based on four sentences with simple grammatical structure (subject-verb-object) with neutral content (for example, *Renato reads the newspaper*). The sentences are not the same as those used as stimuli in the linguistic prosody tasks. Each sentence was previously recorded on audio equipment with three different emotional intonations (happy, sad and angry), making a total of twelve stimuli, presented in random order. The test subject is asked to identify the intonation verbally or with a motor response (pointing to one of three presented images, happy face, sad face of angry face).

*Emotional prosody repetition.* This subtest examines the ability to verbally reproduce emotional intonation and is based no the same four sentences as the previous task. The examiner instructs the test subject to repeat each sentence with the same identified intonation.

*Interpretation of indirect speech.* This task examines the ability to understand direct and indirect speech through a determined communicative context. It is composed of twenty randomly distributed brief situations; of these, 10 situations end with some form of direct speech in which the speaker literally means what they say (for example, *This new television works really well* meaning *This new television is good*); the other 10 are situations ending in a form of indirect speech in which the speaker´s intention is not explained, needing to be inferred from context (for example, *John, your bedroom door is open* meaning *John, close the door*). The test subject is asked to explain what the person means with their own words after having heard the situation read by the examiner.

*Lexical evocation with semantic criteria.* This task examines the ability to explore lexico-semantic memory during the evocation of words from a semantic criterion. The examiner asks the test subject to say as many words possible that indicate articles of clothing in two minutes.

*Emotional prosody production.* This subtest explores the ability to orally produce patterns of emotional intonation, through contextual clues. It is based on three sentences with simple grammatical structure that must be issued with three different emotional intonation patterns: happy, sad and angry (for example, *I received a letter from my father*). For each sentence, three short stories are constructed so that each of them evokes a different emotion, totaling nine situations. The examiner reads the story and asks the test subject to say the sentence presented visually and verbally with the intonation that expresses the emotion induced by the situation.

*Semantic judgment.* This test assesses the ability to identify semantic relationships between the words, as well as render them clearly and precisely explicit. The stimuli consist of 24 pairs of words, 12 composed of words with a categorical relation (same semantic category). All of the words belong to two pairs, one relation by categorical semantic connection (for example, *rain-snow*), while the other pair doesn't present any relationship within the pair (e.g., knife-rain). Each word pair is presented both verbally and visually. The test subject is asked first to determine if there is a relationship between the two words (yes/no answer, identification score); then, they must explain what the relationship is, when one exists (explanation score).

### *Procedures and Data Analysis*

The MEC Battery was administered in one session, in an environment with appropriate conditions as far as ventilation, light and silence. Application lasted, on average, one hour. The responses given by the participants were recorded on audio equipment for later transcription and analysis. The studies for standardization and verification of reliability of the MEC Battery were effected through specific procedures.

*Standardization*. Responses to all of the MEC Battery tasks were interpreted and scored by the same evaluator, a neuro-psychologist in the application and scoring of the data from this instrument. The normative data were analyzed via descriptive statistical analysis, with establishment of averages and standard deviation. Additionally, the tenth percentile and an alert point for each task were analyzed in each of the normative groups, maintaining the same procedures as the standardization of the original instrument MEC Protocol. The alert point corresponds to the result from which the examiner must assume the communicative disorders found are related to right-hemisphere brain injury (Joanette et al., 2004; Côté et al., 2004). It was established, in general, at the 10th percentile.

However, some adjustments were encouraged through the two specialist judges´ analysis, whenever a modification was determined to be relevant. The principal objective was to avoid false negatives. Two modifications were effected. In the first, the alert point was slightly modified when the 10th percentile was not a whole number. For the decision to increase or decrease the $10^{th}$ percentile, the criterion was, in general, to round up to the next whole number. The $10^{th}$ percentile was rounded down to the previous whole number whenever this change transformed the relationship between the alert point and the standard deviation. This decrease was made to maintain, at the least, alert points above the standard deviation or to alter them to be 1.5 standard deviations. In the second modification, the alert point was generated from the increase or decrease of a whole from the 10th percentile, when this also was a whole number. The increase occurred when the distribution of the data, visually analyzed with histograms, showed that the distribution was concentrated significantly from the first score. The decrease occurred when the 10th percentile was below a standard deviation.

*Reliability.* Two procedures were used: analysis of the internal consistency by the alpha Cronbach coefficient and reliability among the evaluators. For analysis by the Cronbach alpha coefficient, all of the MEC Battery tasks grouped by items were included, or rather, the discursive conversational and verbal fluency tasks (free, with orthographic criteria and with semantic criteria) were not analyzed. Furthermore, the Cronbach Alpha was also verified for each process, from the union of the task items that evaluate the same communicative processing: (a) discursive processing: narrative discourse (partial re-telling) and narrative discourse - questions; (b) pragmatic-inferential processing: interpretation of metaphors and interpretation of indirect speech; (c) lexico-semantic processing, prosodic linguistic repetition, prosodic emotional comprehension, prosodic emotional repetition and prosodic emotional production.

The processing of reliability among evaluators was effected through the interpretation of the data from the MEC Battery tasks from 15% of the sample from this study by three independent evaluators. Forty-five protocols from the 300 participants from the sample were conscripted. The number of participants was based on a sampling calculation that verified what would be the sample size necessary to do a correlative test assuming a null hypothesis with a Pearson coefficient $p = .84$ and power of 80% to detect an alternative hypothesis of $p = .94$. The test used was the Fisher's $z$ test (0.05 two-tailed), program Query version 3. In this case, the minimum number or protocols to be analyzed would be 33, which represents 11% of the total sample of participants ($n = 300$). With 45 participants, the detection power of the alternative hypothesis increased to 85%. The evaluators were rigorously trained for use of the Manual Application and Scoring of the MEC Battery (Fonseca et al., in press-a). Those tasks whose responses were direct were not analyzed with this procedure. This way, the prosodic linguistic comprehension and prosodic emotional comprehension were not included in the measurement of the responses that did not require judgment directly given by the test subject (type of intonation identified). The lexical evocation tasks were also not included, since they are scored according to the number of words evoked. Finally, the semantic judgment task (identification score) was also not included in this procedure, as its responses are of the yes/no type. Agreement among the three evaluators was analyzed by establishment of an average rate of agreement for each task, percentage items with agreement among the three evaluators, based on the total of items from each task (Andres & Marzo, 2004; Fleiss, 1975). The coefficients traditionally used, Kendall, Kappa and Spearman, could not be used in this study, since a large homogeneity was verified in the scores given by the different evaluators for the sample subjects, which generated insufficient variation for the statistical calculations for these coefficients.

Regarding the ethical aspects of the study, the research project was approved by the Ethical Research Committee of the Clinical Hospitals of Porto Alegre (protocol number 06-283). All of the participants signed a free and clear consent form, participating in the study voluntarily, and without payment.

## Results

The normative data for each MEC Battery task, stratified by age and educational level, are displayed in Tables 2 and 5. The data from the tasks that evaluate discursive processing are shown in Table 2. The data from the tests that evaluate pragmatic-inferential processing are shown in Table 3. Data from the subtests for lexico-semantic processing are displayed in Table 4. And, finally, Table 5 displays the data for the tasks that evaluate prosodic processing.

It was noted that the alert points are evidentially higher in the high academic level group, regardless of age group. Additionally, it was noted, still, that the 10th percentile and the alert point are between one and two standard deviations, approaching, most of the time, 1.5 standard deviations.

As far as the results of the reliability study of the MEC Battery, Table 6 shows the data regarding the internal consistency of the instrument, with the Cronbach alpha for each task, as well as the grouping of tasks that evaluate the same processing.

Looking at Table 6, it is clear that, with the exception of the interpretation of indirect speech task, the Cronbach alpha is located between .70 and .90. When the tasks were grouped according to the processing evaluated, the lowest

Table 2
*Normative Data for the MEC Battery Tasks that Evaluate Discursive Processing*

| Groups | Young adults | | Middle-aged adults | | Elderly adults | |
|---|---|---|---|---|---|---|
| | LE | HE | LE | HE | LE | HE |
| Conversational discourse | | | | | | |
| *M* (*SD*) | 30.82 (1.89) | 32.20 (1.52) | 30.50 (1.76) | 30.78 (1.84) | 29.66 (2.43) | 30.48 (2.47) |
| 10th percentile (PA) | 28.10 (28) | 30.00 (30) | 29.00 (28) | 27.10 (28) | 27.00 (27) | 27.00 (27) |
| Narrative discourse: partial retelling (inf. essential) | | | | | | |
| *M* (*SD*) | 9.44 (3.56) | 14.98 (2.43) | 10.40 (3.25) | 13.80 (2.90) | 10.48 (3.76) | 13.40 (2.13) |
| 0th percentile (PA) | 5.00 (5) | 12.00 (12) | 6.00 (6) | 9.00 (9) | 4.10 (5) | 11.00 (11) |
| Narrative discourse: partial retelling (inf. present) | | | | | | |
| *M* (*SD*) | 13.18 (5.26) | 20.90 (3.48) | 14.30 (4.40) | 19.14 (4.49) | 14.50 (5.24) | 18.58 (3.02) |
| 10th percentile (PA) | 6.10 (7) | 17.10 (17) | 8.10 (9) | 12.10 (12) | 7.10 (8) | 15.00 (15) |
| Narrative discourse: complete retelling | | | | | | |
| *M* (*SD*) | 7.34 (3.48) | 10.82 (2.22) | 7.18 (2.70) | 10.36 (2.01) | 7.30 (3.21) | 10.18 (1.79) |
| 10th percentile (PA) | 2.00 (3) | 8.00 (8) | 3.10 (4) | 7.00 (7) | 2.00 (2) | 8.00 (8) |
| Narrative discourse: comprehension questions | | | | | | |
| *M* (*SD*) | 8.74 (2.50) | 10.78 (1.63) | 8.98 (2.98) | 10.62 (1.65) | 8.44 (2.70) | 10.12 (1.82) |
| 10th percentile (PA) | 5.00 (5) | 8.10 (8) | 4.00 (4) | 8.00 (8) | 5.00 (5) | 8.00 (8) |

*Note*. LE = low educational level; HE = high educational level; PA = point of alert.

Table 3
*Normative Data for the MEC Battery Tasks that Evaluate Pragmatic-Inferential Processing*

| Groups | Young adults | | Middle-aged adults | | Elderly adults | |
|---|---|---|---|---|---|---|
| | LE | HE | LE | HE | LE | HE |
| Interpretation of metaphors | | | | | | |
| *M* (*SD*) | 28.02 (6.28) | 35.28 (3.25) | 27.61 (5.75) | 34.18 (3.91) | 27.14 (5.35) | 31.78 (4.03) |
| 10th percentile (PA) | 19.00 (19) | 32.00 (32) | 21.00 (21) | 28.10 (28) | 18.10 (19) | 25.00 (25) |
| Interpretation of indirect speech | | | | | | |
| *M* (*SD* | 29.18 (4.85) | 33.96 (2.92) | 29.80 (4.02) | 31.98 (3.10) | 30.60 (3.96) | 32.20 (3.44) |
| 10th percentile (PA) | 22.00 (22) | 29.00 (29) | 23.10 (23) | 29.00 (29) | 26.00 (26) | 27.00 (27) |

*Note*. LE = low educational level; HE = high educational level; PA = point of alert.

Table 4
*Normative Data for the MEC Battery Tasks that Evaluate Lexical-Semantic Processing*

| Groups | Young adults | | Middle-aged adults | | Elderly adults | |
|---|---|---|---|---|---|---|
| | LE | HE | LE | HE | LE | HE |
| Free lexical evocation | | | | | | |
| *M* (*SD*) | 39.66 (21.39) | 61.88 (23.88) | 39.56 (18.51) | 56.78 (24.02) | 31.46 (14.40) | 43.72 (16.11) |
| 10th percentile (PA) | 15.00 (15) | 30.30 (31) | 18.30 (19) | 27.20 (28) | 15.00 (15) | 25.10 (26) |
| Lexical evocation with orthographic criteria | | | | | | |
| *M* (*SD*) | 20.54 (8.84) | 27.06 (6.92) | 17.44 (7.25) | 26.22 (8.04) | 16.46 (6.26) | 21.36 (8.74) |
| 10th percentile (PA) | 10.10 (11) | 17.10 (18) | 9.00 (9) | 17.00 (17) | 8.10 (9) | 12.10 (12) |
| Lexical evocation with semantic criteria | | | | | | |
| *M* (*SD*) | 20.96 (6.67) | 30.98 (6.29) | 20.78 (5.68) | 28.42 (7.68) | 18.28 (4.45) | 23.48 (5.57) |
| 10th percentile (PA) | 13.10 (14) | 22.00 (22) | 14.00 (14) | 18.10 (19) | 13.00 (13) | 16.10 (17) |
| Semantic judgment: identification | | | | | | |
| *M* (*SD*) | 21.82 (2.42) | 23.52 (0.97) | 22.22 (1.99) | 23.28 (1.27) | 21.72 (2.56) | 23.56 (0.67) |
| 10th percentile (PA) | 18.00 (18) | 23.00 (22) | 18.10 (19) | 21.10 (21) | 18.00 (18) | 23.00 (22) |
| Semantic judgment: explanation | | | | | | |
| *M* (*SD*) | 6.78 (3.19) | 10.38 (1.47) | 7.04 (2.61) | 9.50 (1.76) | 6.68 (2.88) | 10.32 (1.47) |
| 10th percentile (PA) | 2.00 (2) | 8.10 (8) | 3.00 (3) | 7.00 (7) | 2.00 (2) | 8.00 (8) |

*Note*. LE = low educational level; HE = high educational level; PA = point of alert.

Table 5
*Normative Data for the MEC Battery Tasks that Evaluate Prosodic Processing*

| Groups | Young adults | | Middle-aged adults | | Elderly adults | |
|---|---|---|---|---|---|---|
| | LE | HE | LE | HE | LE | HE |
| Prosody linguistic comprehension | | | | | | |
| *M* (*SD*) | 8.14 (2.57) | 11.38 (1.42) | 7.56 (2.88) | 10.86 (1.57) | 8.56 (2.35) | 10.96 (1.49) |
| 10th percentile (PA) | 4.10 (5) | 10.00 (9) | 3.00 (3) | 8.10 (9) | 5.10 (6) | 9.00 (9) |
| Linguistic prosody repetition | | | | | | |
| *M* (*SD*) | 10.38 (1.89) | 11.76 (0.55) | 10.38 (1.85) | 11.58 (1.05) | 10.70 (1.76) | 11.40 (1.19) |
| 10th percentile (PA) | 8.00 (8) | 11.00 (11) | 8.00 (8) | 10.10 (10) | 8.00 (8) | 9.10 (9) |
| Emotional prosody - comprehension | | | | | | |
| *M* (*SD*) | 10.42 (1.98) | 11.70 (1.07) | 9.70 (2.68) | 11.62 (0.69) | 9.06 (2.43) | 10.60 (1.71) |
| 10th percentile (PA) | 8.00 (8) | 11.00 (10) | 5.00 (5) | 11.00 (10) | 6.00 (6) | 8.00 (8) |
| Emotional prosody - repetition | | | | | | |
| *M* (*SD*) | 8.32 (2.76) | 10.16 (2.05) | 8.78 (2.43) | 10.36 (2.08) | 8.82 (2.60) | 7.96 (2.63) |
| 10th percentile (PA) | 4.00 (4) | 6.10 (6) | 5.10 (5) | 8.00 (8) | 4.10 (4) | 5.00 (5) |
| Emotional prosody - production. | | | | | | |
| *M* (*SD*) | 11.48 (3.61) | 14.22 (3.52) | 11.26 (3.92) | 15.10 (2.86) | 11.32 (4.10) | 12.42 (4.09) |
| 10th percentile (PA) | 6.00 (6) | 9.10 (10) | 5.00 (5) | 12.00 (12) | 5.10 (5) | 6.10 (6) |

*Note*. LE = low educational level; HE = high educational level; PA = point of alert.

Table 6
*Cronbach Alpha for each Task and for the Four Communicative Processes of the MEC Battery*

| Tasks and processes | Cronbach Alpha |
|---|---|
| Interpretation of metaphors. | .75 |
| Prosody linguistic - comprehension | .78 |
| Linguistic prosody - repetition. | .70 |
| Narrative discourse - essential and present information (partial retelling) | .90 |
| Narrative discourse - questions | .72 |
| Emotional prosody - comprehension. | .78 |
| Emotional prosody - repetition. | .74 |
| Interpretation of indirect speech. | .54 |
| Emotional prosody - production. | .76 |
| Semantic judgment - identification score | .73 |
| Semantic judgment - relations score | .77 |
| Discursive processing | .88 |
| Pragmatic-inferential processing | .76 |
| Lexico-semantic processing | .85 |
| Prosodic processing | .90 |

Table 7
*Average Rates of Agreement among Evaluators in the Reliability Procedure*

| Tasks | Average rates of agreement |
|---|---|
| Conversational discourse | .77 |
| Interpretation of metaphors | .83 |
| Linguistic prosody - repetition | .92 |
| Narrative discourse (essential and present information) | .94 |
| Emotional prosody - repetition | .77 |
| Interpretation of indirect speech | .87 |
| Emotional prosody - production | .62 |
| Semantic judgment - relations score | .92 |

Cronbach alpha found was .76. Complimentary to the alpha coefficient, the average rates of agreement between the evaluators is displayed in Table 7.

As far as the average rates of agreement among evaluators, shown in Table 7, with the exception of the prosodic emotional production task, all varied between .77 and .94.

## Discussion

The goal of presenting norms in respect to academic level and age and to verify the psychometrical parameter of reliability of the Brazilian MEC Battery was achieved in this study. In respect to the first expectation, the 10th percentiles and the alert points are evidently shown higher in the normative groups of higher academic level than in the low academic level groups. The difference between age groups was less clear. This pattern was similar to that presented in the *MEC Protocol* manual (Joanette et al., 2004) and in the prior MEC Battery study (Fonseca et al., 2007), demonstrating that the Brazilian population, just as the Canadian, perform differently according to their age and their educational level. Significant differences were observed among individuals of low and high educational level, as well as between young adults and elderly adults and between middle-aged adults and elderly adults. In this way, it was noted that the formation of the six normative groups was important and sufficient for the standardization process for the MEC Battery.

Analysis of the normative data from this study still showed that the 10th percentile and the consequent alert point approach the cut-off point of 1.5 standard deviations, a bit below the cut-off point traditionally used in the clinical context for identification of a neuro-psychopathological performance, which is two standard deviations (Schwartz et al., 2000). The greatest approximation of the alert points of 1.5 standard deviations from that of two standard deviations appears to be more appropriate to diagnosis of communicative disorders after right-hemisphere brain injury, in the measurement in

which these disorders are subtle and manifest themselves in a heterogeneous manner (Brookshire, 2003). To reinforce this hypothesis, in the normative study from Zanini et al. (2005), of the Italian Right Hemisphere Language Battery, scores corresponding to the 1.5 standard deviation were found in the 10th percentile, approximately. In this way, the alert point based on the 10th percentile appears to be appropriate for identification of a communicative disorder after right-hemisphere brain injury.

Although distribution of normative groups by age and educational level in neuropsychological studies is frequent (for example, Ostrosky-Solís et al., 1999), one of the limits of the current research was the absence of control by the gender factor. Some studies of the standardization of neuropsychological instruments consider the gender variable, such as Van der Elst, Van Boxtel, Van Breukelen and Jolles (2006). However, the influence of gender on neuropsychological performance is not referred to in a consensual way in the literature. While some studies show that men and women differ in verbal fluency abilities (Acevedo et al., 2000), prosody (Rymarczyk & Grabowska, 2007) and neuropsychological batteries, as a whole (Collie, Shafiq-Antonacci, Maruff, Tyler, & Currie, 1999), others reveal no difference in verbal fluency (Brickman et al., 2005), and conversational discourse (Mackenzie, 2000), among others.

As far as reliability, the MEC Battery has been shown to be a relatively reliable tool for evaluation of communication. Based on the first procedure used, the alpha Cronbach coefficient, it was noted that the coefficients by task are located above .70. This showed that the MEC Battery tasks appear to be reliable, even though the ideal coefficient would be .80 or higher, since only coefficients below .60 indicate unreliability (Pasquali, 2003; Sattler, 2001; Urbina, 2004). One task showed a coefficient higher than 0.80, narrative discourse (partial retelling), and one task had a coefficient below .60 (interpretation of indirect speech). As far as the discursive narrative subtest, it was expected that it would present the best consistency internal to the MEC Battery. This is because each bit of textual information retold by the subjects was explicitly or implicitly connected to the other information in the narrative, due to the psycholinguistic characteristics of textual cohesion and coherency on which the construction of the original and adaptive narratives are based.

On the other hand, the low coefficient of .54 on the interpretation of indirect speech subtest may be related to two factors. The first involves the fact that this test assesses pragmatic-inferential processing, which, despite generally being more automatic, was rendered difficult by the complexity and artificiality of the task. These characteristics may have contributed to a greater variability in responses, with a probably greater number of explanations in the event of errors. This is because it is a subtest that requires meta-linguistic and meta-cognitive abilities: to think about the language. When a person expresses themselves in daily life, their communicative intention is automatic. On the other hand, in the task of interpreting indirect speech, the individual has to form a situational image to identify the intention of the speaker. This way, the distance between daily communication and meta-language necessary for the execution of this test becomes a little more artificial than in the other tests. Additionally, the second factor corresponds to the participants´ tendency to classify the speech as direct or indirect. This task is composed of 10 target situations which are indirect speech said in 10 distracting situation, acts of direct speech; the presence of distracting factors in the pragmatic-inferential processing exam may require a greater number of items, such as ten more instances of direct speech and ten indirect. This last explanation is corroborated by the highest coefficient for internal consistency in the tasks of interpretation of metaphors and interpretation of indirect speech together, 0.76. The union of these items from the two pragmatic-inferential tasks likely contributed to the increase in the Cronbach alpha, since the amount of items is a variable that influences the reliability of a test (Pasquali, 2003).

Complimentary to the Cronbach alpha in the precision between evaluators, the average rates of agreement varied between good and excellent, according to the categorization proposed by Cicchetti and Sparrow (1981). Agreement coefficients from the following tasks were considered excellent (between .75 and 1.0): (a) conversational discourse, (b) interpretation of metaphors and indirect speech, (c) linguistic and emotional prosody repetition (d) semantic judgment. The rate of agreement in the emotional prosody task was considered good. A lower index of agreement between evaluators in this subtest may be related to the subjectivity of this evaluation. Furthermore, the necessity for more refined auditory discrimination in the tasks for evaluation of the prosodic curves when there is no examiner model for the evaluators to use as a basis may also have generated greater variability among the evaluators. Thus, as all of the agreement coefficients are found above 0.60, this second procedure of the study of MEC Battery precision demonstrated high agreement among evaluators, complementing the finding of the alpha technique.

## Conclusions

From this study, norms stratified by age and educational level were presented for the MEC Battery, encompassing a sample of 19 to 75 years of age, with two or more years of schooling. Furthermore, two indications of reliability were studied: internal consistency with the Cronbach alpha, and precision among evaluators.

The normative data for the MEC Battery will contribute to the diagnostic process for communication disorders in respect to right hemisphere brain injury, as well as other neurological illnesses that cause impairment of functional processing of language, such as cranio-encephalic trauma,

dementia, frontal lobe injuries, among others, in Brazilian clinical neuropsychology. However, for this process to be considered complete, it is suggested that the MEC Battery also be normalized for gender.

Confirmation of the reliability of this assessment tool consisted in partial empirical evidence that the MEC Battery tasks can be used for precise investigation of the communicative process in the Brazilian context. Other evidence of reliability may yet be verified: test-retest technique and two halves technique. For the diagnostic accuracy of the MEC Battery to be corroborated, continued studies on the psychometric criteria of the MEC Battery are important to verify the sensitivity and specificity of this instrument.

## References


Acevedo, A., Loewenstein, D.A., Barker, W.W., Harwood, D.G., Luis, C., Bravo, M., Hurwitz, D.A., Aguero, H., Greenfield, L., & Duara, R. (2000). Category fluency test: Normative data for English- and Spanish-speaking elderly. *Journal of the International Neuropsychological Society, 6*, 760-9.

Andres, A.M., & Marzo, P.F. (2004). Delta: A new measure of agreement between two raters. *British Journal of Mathematical & Statistical Psychology, 57*, 1-19.

Braun, C.M.J., & Crépeau, F. (1997). *Évaluation neuropsychologique*. Montréal: Décarie Éditeur.

Brickman, A.M., Paul, R.H., Cohen, R.A., Williams, L.M., MacGregor, K.L., Jefferson, A.L., Tate, D.F., Gunstad, J., & Gordon, E. (2005). Category and letter verbal fluency across the adult lifespan: Relationship to EEG theta power. *Archives of Clinical Neuropsychology, 20,* 561-573.

Brookshire, R.H. (2003). *Introduction to neurogenic communication disorders*. St. Louis, MO: Mosby Year Book.

Bryan, K.L. (1995). *The Right Hemisphere Language Battery* (2nd edition). London, UK: Whurr.

Chaves, M. L., & Izquierdo, I. (1992). Differential diagnosis between dementia and depression: A study of efficiency increment. *Acta Neurologica Scandinavia, 11,* 412-429.

Cicchetti, D.V., & Sparrow, S.S. (1981). Developing criteria for establishing interrater reliability of specific items: Applications to assessment of adaptive behavior. *American Journal of Mental Deficiency, 86*, 127-137.

Collie, A., Shafiq-Antonacci, R., Maruff, P., Tyler, P., & Currie, J. (1999). Norms and the effects of demographic variables on a neuropsychological battery for use in healthy ageing Australian populations. *Australian and New Zealand Journal of Psychiatry, 33*, 568-75.

Côté, H., Moix, V., & Giroux, F. (2004). Évaluation des troubles de la communication des cérébrolésés droits. *Rééducation Orthophonique, 219*, 107-122.

Fleiss, J.L. (1975). Measuring agreement between two judges on the presence or absence of a trait. *Biometrics, 31*, 651-659.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state. *Journal of Psychiatry Resources, 12,* 189-198.

Fonseca, R.P., Côté, H., Joanette, Y., Ska, B., Giroux, F., & Parente, M.A.M.P. (2007). Age and education effects on adults performance in the Brazilian version of Montreal Communication Evaluation Battery – Protocole MEC. Submitted to *Archives of Clinical Neuropsychology*, 2007. Manuscript submitted for publication.

Fonseca, R.P., Parente, M.A.M.P., Côté, H., & Joanette, Y. (2007). Processo de adaptação da Bateria Montreal de Avaliação da Comunicação – Bateria MAC – ao Português Brasileiro. *Psicologia: Reflexão e Crítica, 20, (2)*, 259-267.

Fonseca, R.P., Parente, M.A.M.P., Côté, H., Ska, B., & Joanette, Y. (2008). *Bateria Montreal de Avaliação da Comunicação – Bateria MAC*. São Paulo: Pró-Fono.

Fratalli, C.M., Thompson, C.M., Holland, A.L., Wohl, C.B., & Ferketic, M.M. (1995). *Functional Assessment of Communication Skills for Adults – ASHA FACS*. Rockville, MD: ASHA.

IBGE (2003). Instituto Brasileiro de Geografia e Estatística, Censo demográfico 2000. IBGE, Rio de Janeiro.

Jin, H., Folsom, D.P., Lindamer, L., Bailey, A., Hawthorne, W., Garcia, P., & Jeste, D.V. (2003). Patterns of public mental health service use by age in patients with schizophrenia. *American Journal of Geriatric Psychiatry, 11*, 525-533.

Joanette, Y., Ska, B., & Côté, H. (2004). *Protocole MEC – Protocole Montreál d'Évaluation de la Communication*. Montreal, Canada: Ortho Édition.

Lezak, M. D., Howieson, D. B., & Loring, D. W. (2004). *Neuropsychological assessment*. New York: Oxford University Press.

Mackenzie, C. (2000). Adult spoken discourse: The influences of age and education. *International Journal of Communication Disorders, 35*, 269-285.

Myers, P.S. (1999). *Right hemisphere damage: Disorders of communication and cognition.* San Diego, CA: Singular Publishing Group.

Ostrosky-Solís, F., Ardila, A., & Rosselli, M. (1999). NEUROPSI: A brief neuropsychological test battery in Spanish with norms by age and educational level. *Journal of the International Neuropsychological Society, 5,* 413-433.

Parente, M.A.M.P. (1990). *Versão brasileira da Escala de Depressão Geriátrica*. Unpublished manuscript.

Pasquali, L. (2003). *Psicometria: teoria dos testes na psicologia e na educação* (1st ed.). Petrópolis, Brazil: Vozes.

Pimental, P.A., & Kingsbury, N.A. (1989). *Mini Inventory of Right Brain Injury*. Austin, TX: PRO-ED.

Plumet, J. Gil, R., & Gaonac'h, D. (2005). Neuropsychological assessment of executive functions in women: Effects of age and education. *Neuropsychology, 19*, 566-577.

Radanovic, M., Mansur, L.L., & Scaff, M. (2004). Normative data for the Brazilian population in the Boston Diagnostic Aphasia Examination: Influence of schooling. *Brazilian Journal of Medical and Biological Research, 37*, 1731-1738.

Rymarczyk, K., & Grabowska, A. (2007). Sex differences in brain control of prosody. *Neuropsychologia, 45*, 921-930.

Sattler, J.M. (2001). *Assessment of children: Cognitive applications* (4th ed.). San Diego: Jerome M. Sattler.

Schwartz, R.L., Adair, J.C., Rayme, A.M., Williamson, D.J., Crosson, B., Rothi, L.J., Nadeau, S.E., & Heilman, K.M. (2000). Conceptual apraxia in probable Alzheimer's disease as demonstrated by the Florida Action Recall Test. *Journal of the International Neuropsychological Society, 6*, 265-270.

Strauss, E., Sherman, E.M.S., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms and commentary* (3rd ed.). New York: Oxford University Press.

Tallberg, I.M. (2005). The Boston Naming Test in Swedish: Normative data. *Brain and Language, 94,* 19-31.

Urbina, S. (2004). *Essentials of psychological testing*. Hoboken, NJ: Wiley & Sons.

Van der Elst, W., Van Boxtel M.P.J., Van Breukelen, G.J.P., & Jolles, J. (2006). Normative data for the animal, profession and letter naming verbal fluency tests for Dutch-speaking participants and the effects of age, education, and sex. *Journal of the International Neuropsychological Society, 12*, 80-89.

Yesavage, J. A. (1986). The use of self-rating scales for depression in the elderly. In L.W. Poon (Ed.), *Handbook for clinical memory assessment of older adults* (pp. 246-368). Washington, DC: American Psychological Association.

Zanini, S., Bryan, K., De Luca, G., & Bava, A. (2005). Italian Right Hemisphere Language Battery: The normative study. *Neurological Sciences, 26,* 13-25.

Received January 21, 2007
Revision received May 28, 2007
Accepted July 16, 2007