Translation into Brazilian Portuguese, cross-cultural adaptation, reliability and validation of the Functional Ambulation Classification for the categorization of ambulation following a stroke in a clinical setting

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Introduction. The Functional Ambulation Classification (FAC) is the only scale that classifies the gait of individuals with multiple sclerosis and stroke victims into ambulation categories. However, the FAC is only available in English and studies conducted in Brazil have used the FAC without an adequate translation and analysis of its measurement properties.

Aim. To translate, cross-culturally adapt the FAC to Brazilian Portuguese, test its reliability and concurrent validity on stroke survivors.

Patients and methods. The translation and cross-cultural adaptation involved six steps. Inter-observer reliability was tested with five physiotherapists who watched videos of the gait of the stroke survivors and watched a second time after at least one week for the determination of intra-observer reliability. Concurrent validity was determined by correlating the FAC with the result of the 10-meter Walk Test (10mWT).

Results. Intra-observer reliability ranged from kappa 0.680 to 0.952 ($p = 0.001$) and inter-observer reliability ranged from kappa 0.517 to 0.794 ($p = 0.001$). The correlation between the FAC and 10mWT was $r_s = 0.771$ ($p = 0.001$).

Conclusion. The translation, cross-cultural adaptation and measurement properties demonstrated that the FAC is a valid, reliable clinical measure for the categorization of ambulation in the Brazilian population of stroke survivors in a clinical setting.

Key words. Functional Ambulation Classification. Reproducibility of results. Stroke. Translations. Validation studies. Walking.

Introduction

According to the World Health Organization, stroke is considered the second major cause of death in the world and the third major cause of functional disability [1]. It is estimated that 25-74% of the 50 million stroke survivors throughout the world are dependent on others regarding activities of daily living [2,3].

Motor impairment is highly prevalent following a stroke. Affected individuals have functional limitations that can restrict their activities and social participation [4,5], with locomotion is one of the most affected aspects [6]. According to the concepts of the International Classification of Functioning, Disability and Health (ICF), locomotion is defined as the capacity to move effectively through the surrounding environment and is classified in the activity domain [6]. As an important functional outcome, diverse assessment tools have been developed for the analysis of human locomotion, such as the analysis of spatiotemporal variables, gait veloc-

ity tests, functional scales, and kinetic and kinematic analyses. Such assessment tools are complex, time consuming, costly and often difficult to encounter in outpatient clinical practice. Moreover, the administration of these instruments requires training on the part of the therapist.

Therefore, it is important to have a low-cost, simple, fast, accessible method for evaluating individuals with different degrees of ambulation capacity. The Functional Ambulation Classification (FAC) was developed by Holden et al in 1984 [7] and has been widely used as an assessment tool for measuring walking capacity. This predictive, evaluative, discriminative scale can be used in a small environment, which facilitates its use in clinical practice.

The FAC distinguishes six levels of ambulation according to the amount of physical support required. During the test, ambulation capacity is evaluated on flat and uneven surfaces for at least three meters as well as walking on ramps and going up and down stairs. Previous studies have demon-

strated that the FAC is correlated with spatiotemporal gait variables [7-9].

Specifically regarding the concepts addressed by the ICF, a recent study reports that the FAC is correlated with persistent disability regarding activities of daily living that limits the independence of stroke survivors [10]. The FAC also has adequate reliability and statistically significant concurrent validity and reproducibility [9] and serves as a means of following up the progression of gait in rehabilitation processes.

The FAC is the only scale that classifies the gait of individuals with multiple sclerosis and stroke victims into ambulation categories [7]. In the study by Mudge and Stott [11], one of the objectives was to investigate the frequency of use of 61 gait assessment tools (clinical and laboratory methods) on stroke victims. The authors found that the FAC was the sixth most used method in general and the fourth when considering only clinical methods.

However, the FAC is only available in English. Moreover, its psychometric properties (concurrent validity, predictive validity, intra-observer and inter-observer reliability) for stroke survivors have only been tested in the acute and sub-acute phases of the rehabilitation process in the hospital setting [9], with no determination of these properties in the clinical setting.

Studies conducted in Brazil have used the FAC without an adequate translation and analysis of its measurement properties [12-14]. Several factors can affect the administration of a scale, such as the culture of the target population, the reliability, reproducibility and validation of the measure, the training and skill of the examiner, and the functional status of the individual being evaluated. In the case of the FAC, issues such as its application in the clinical setting and cultural issues, such as the type of irregular ground and unit of measurement regarding the distance travelled during the test, can exert an influence on the results in different populations.

Therefore, the aim of the present study was to translate and cross-culturally adapt the FAC to Brazilian Portuguese and test its measurement properties (reliability and validity) in a clinical setting.

Patients and methods

Study design

A methodological cross-sectional study was conducted. Forty individuals were involved during the translation and cross-cultural evaluation process,

following the guidelines proposed by Beaton et al [15]. Sixty-one individuals were involved in the phase for the determination of reliability and concurrent validity, as proposed the guidelines, who suggest evaluating a minimum of 50 individuals for an adequate analysis of reliability [16,17].

The sample was composed of stroke survivors recruited from the physical therapy clinic of University Nove de Julho. To be included, the individuals needed to have a diagnosis of stroke in the chronic phase (> 6 months) [18] and preserved cognition, evaluated using the Mini Mental State Examination (MMSE), with cutoff points based on schooling: ≥ 13 points for illiterate individuals; 18 points for those with low to mid-level schooling; and 26 for those with high schooling [19]. Individuals with orthopedic or neurological conditions other than stroke that altered gait and those with no motor impairment were excluded from the study.

This study received approval from the Human Research Ethics Committee of University Nove de Julho in São Paulo, Brazil (certificate no. 79057817.4.0000.5511). All participants and legal guardians of the volunteers received clarifications regarding the objectives and procedures of the study and those who agreed to participate signed a statement of informed consent. An attempt was made to contact the author of the scale to request authorization for the translation, cross-sectional adaptation and analysis of the measurement properties, but we received no response. However, as the scale is in the public domain and widely used in clinical practice, the decision was made to proceed with the study, considering its clinical relevance.

Translation and cross-cultural adaptation

The translation and cross-cultural adaptation of the original English-language version of the FAC [8] to Brazilian Portuguese was performed following the guidelines proposed by Beaton et al [15], which consists of six stages:

- *Stage 1.* The first stage consists of performing two independent translations from the language of origin to the target language (English to Brazilian Portuguese). For such, two bilingual translators whose native language was Portuguese performed the translations independently. translator 1 (T1) was aware of the concepts of the questionnaire and translator 2 (T2) was 'naïve' (unaware of the concepts of the questionnaire) [15].
- *Stage 2.* The second stage consisted of the synthesis of the two translations into a single, combined translation (T-12), forming a translated ver-

sion based on the two previous translations (T1 and T2) and the original version of the questionnaire [15].

– *Stage 3.* The third stage consisted of back-translating the T-12 version into the language of origin (English) to verify the validity, point out gross or conceptual mistakes and determine whether the translated version adequately reflected the original version. Two back-translations (BT1 and BT2) were performed by two independent translators whose native language was English. Neither of these translators was aware of the concepts of the questionnaire [15].

– *Stage 4.* In this stage, all translations (T1, T2, T12, BT1 and BT2) and reports explaining all the decisions made during the previous stages of the translation process were submitted to a board of specialists composed of all health professionals and researchers who were involved in the translation and cross-cultural adaptation process. The committee made decisions to ensure semantic, idiomatic, experiential and conceptual equivalence, giving rise to the pre-final version of the translated scale to be tested [15].

– *Stage 5.* The pre-final version of the scale was tested. The classification of the ambulation of each patient based on the FAC levels was performed using videos of individual patients (front and side views). When the participant was capable, a three-meter walk on a level surface and another on a non-level surface (mats with different densities) were also recorded. Also when possible, the volunteer was recorded going up and down at least seven steps and going up and down a ramp with a 30° inclination or more. The patients could use braces, the handrail on the stairs and ramp and receive assistance or supervision from the physiotherapists when necessary. Two physiotherapists with at least five years of experience in adult neurological rehabilitation were recruited separately to watch the videos of 40 stroke survivors and classify each individual based on the FAC levels. At the end of the classification, the physiotherapists reported their doubts regarding the scale [15].

– *Stage 6.* The final stage involved the presentation of all reports to the expert committee that accompanied the translation process. The committee verified that the reports reflected the entire process and that all stages had been fulfilled [15].

Intra-observer and inter-observer reliability

The guidelines proposed by Terwee et al [16] were followed for the analysis of intra-observer and inter-observer reliability. For, such 61 individuals were recruited. Each participant was video recorded walking. The video recording followed the same specifications used in the article on the development and validation of the original version of the FAC.

For the intra-observer analysis, five physiotherapists with at least five years of experience in neurological rehabilitation analyzed the videos independently and classified the patients.

After at least seven days, the examiners analyzed the videos a second time in a random order to avoid the effect of memorization [7,9]. The classifications of the examiners were compared for the determination of inter-observer agreement.

Concurrent validity

The same 61 individuals recruited for the reliability analysis performed the 10-meter walk test (10mWT), which is significantly correlated with measures of gait capacity. Moreover, gait speed tests are widely used in both rehabilitation programs and research and are indicators of progress in gait performance [9,20,21].

Statistical analysis

The Kolmogorov-Smirnov test was used to determine the normality of the data. Descriptive statistics were used for the characterization of the sample and distribution of the data. Parametric variables were expressed as mean ± standard deviation values, nonparametric variables were expressed as median and interquartile range and categorical variables were expressed as frequencies.

The weighted quadratic kappa statistic was used for the analysis of intra-observer and inter-observer reliability, which is considered the best method for the determination of agreement between examiners and/or evaluations. Kappa coefficients were interpreted as follows: $\kappa \leq 0.20$ = weak agreement; 0.21 to 0.40 = acceptable agreement; 0.41 to 0.60 = moderate agreement; 0.61 to 0.80 = good agreement and > 0.80 = excellent agreement. The level of significance was set to 5% ($p < 0.05$) [22].

Spearman's correlation coefficient (r_s) was used for the analysis of concurrent validity (correlation between FAC and 10mWT). The coefficients were interpreted as follows: 0.10 to 0.39 = weak correlation; 0.40 to 0.69 = moderate correlation; and > 0.70 = strong correlation [23]. The SPSS v. 22 was used for the statistical analysis.

Table I. Changes in translation and cross-cultural adaptation process.

	First translation	Final version
FAC level 2	*'Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas'*	*'Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas para prevenir quedas'*
FAC level 3	*'Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas'* *'O contato manual é contínuo ou intermitente leve para ajudar no equilíbrio ou na coordenação'*	*'Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas para prevenir quedas'* *'O contato manual é leve, contínuo ou intermitente para ajudar no equilíbrio ou na coordenação'*
FAC level 4	*'A deambulação ocorre em superfícies de mesmo nível sem ajuda de outra pessoa'* *'Requer uma pessoa do lado por causa do mau julgamento, status cardíaco questionável, ou da necessidade de verbalização para completar a tarefa'*	*'A deambulação ocorre em superfície do mesmo nível sem ajuda de outra pessoa, mas por segurança, requer uma pessoa ao lado por causa do comprometimento da capacidade de decisão, status cardíaco questionável ou da necessidade de verbalização para completar a tarefa'*
FAC level 5 'to negotiate stairs'	*'Subir escadas'*	*'Deambular em escadas'*
Non-level surface: 'dirt'	*'Sujeira'*	*'Terra'*

The words 'snow' and 'ice' (literally '*neve*' and '*gelo*') were adapted to '*colchonete*'. FAC: Functional Ambulation Classification.

Results

Translation and cross-cultural adaptation

Divergences were found between the two translators (T1 and T2) and the synthesis stage (T12) (Table I).

In the fifth stage, the pre-final version was administered to forty stroke survivors and two physiotherapists individually performed the classification of the ambulation of each participant. The physiotherapists had no questions regarding the interpretation of the scale.

Therefore, the final version was concluded in the sixth stage (Figure).

Reliabilty

Seventy-three individuals were recruited for the reliability analysis. However, four were excluded for cognitive deficit (< 11 points on the MMSE), six for orthopedic conditions that affected walking ability and two for having suffered a stroke less than six months earlier. Thus, 61 individuals participated in this analysis. The demographic and clinical characteristics of the sample are listed in table II.

Table II. Demographic and clinical characteristics of participants in reliability study ($n = 61$).

Sex	Men	37 (60.7%)
	Women	24 (39.3%)
Age (years) [a]		57.3 ± 12.7
Time since stroke (months) [b]		24 (12-54)
Affected side of body	Right	30 (49.2%)
	Left	30 (49.2%)
	Both	1 (1.6%)
Type of stroke	Ischemic	46 (75.4%)
	Hemorrhagic	15 (24.6%)
Schooling (years) [b]		12 (4.5-12)
Mini Mental State Examination (points) [b]		25 (22-27.5)

[a] Mean ± standard deviation; [b] Median (interquartile range).

Intra-observer reliability of the five examiners ranged from good to excellent, whereas inter-observer reliability among the five examiners ranged from moderate to good (Table II).

Concurrent validity

The correlation between the FAC and 10mWT was positive, strong and statistically significant ($r_s = 0.771$; $p = 0.001$).

Discussion

During translation process, the definition of some FAC levels was the object of discussion. For example, on levels 2 and 3, the version on the first translation was '*Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas*' [Requires help from a person during ambulation on level surfaces]. After discussion with the expert committee, however, the decision was made to use '*Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas para prevenir quedas*' [Requires help from a person during ambulation on level surfaces to prevent falls], as it was necessary to clarify that the patient is accompanied throughout the entire evaluation as a safety precaution to avoid possible complications, such as a fall.

Table III. Intra-observer and inter-observer reliability.

	κ	p
Intra-observer 1 (J.A)	0.952	< 0.001
Intra-observer 2 (P.F)	0.708	< 0.001
Intra-observer 3 (D.B)	0.816	< 0.001
Intra-observer 4 (R.B)	0.680	< 0.001
Intra-observer 5 (G.C)	0.876	< 0.001
Inter-observers 1 and 2	0.699	< 0.001
Inter-observers 1 and 3	0.772	< 0.001
Inter-observers 1 and 4	0.729	< 0.001
Inter-observers 1 and 5	0.568	< 0.001
Inter-observers 2 and 3	0.704	< 0.001
Inter-observers 2 and 4	0.616	< 0.001
Inter-observers 2 and 5	0.517	< 0.001
Inter-observers 3 and 4	0.794	< 0.001
Inter-observers 3 and 5	0.747	< 0.001
Inter-observers 4 and 5	0.727	< 0.001

Figure. Translated version of Functional Ambulation Classification (instruction manual and scale).

CLASSIFICAÇÃO FUNCIONAL DE DEAMBULAÇÃO

Informação geral:

- Categoriza os pacientes de acordo com as habilidades motoras básicas necessárias para a deambulação funcional.

- Não avalia resistência.

Instruções:

- Usar as definições abaixo para classificar o paciente em uma categoria.

- Os pacientes devem ser classificados em seu nível mais independente (supervisão ou assistência física necessária para deambular):
Como por exemplo, o paciente é capaz de deambular de forma independente com um andador em superfícies niveladas, mas deambula com muletas sob supervisão, o paciente recebe a classificação "5" (deambulador – apenas em superfícies de mesmo nível).

- Apenas avaliar os pacientes sobre a capacidade de deambular.

- A capacidade de passar de sentado para de pé não deve ser incluída.

Definições:

- Deambulação: O indivíduo pode caminhar pelo menos 3 metros fora das barras paralelas com supervisão ou assistência física de apenas uma pessoa. Pode ser utilizada assistência mecânica de qualquer dispositivo ou auxílio de deambulação (exceto barras paralelas).

- Superfície nivelada: azulejos, tapetes, pavimento.

- Superfície não nivelada: grama, cascalho, terra, colchonete.

- Escadas: subir e descer pelo menos 7 degraus com corrimão.

- Inclinação: inclinação para cima e para baixo de 5 pés (1,52 m) de 30 graus ou mais.

- Supervisão: O paciente é capaz de deambular sem contato manual de outra pessoa, mas requer que outra pessoa esteja perto por segurança. Isso pode ser devido a um comprometimento na capacidade de decisão, status cardíaco questionável, ou da necessidade de verbalização para completar a tarefa.

- Assistência física nível I: É necessário o contato manual de uma pessoa durante a deambulação para evitar queda. O contato manual pode ser contínuo ou intermitente leve para ajudar a equilibrar ou coordenar.

- Assistência física nível II: É necessário o contato manual de uma pessoa para evitar uma suposta queda. O contato manual pode ser contínuo e necessário para suportar o peso corporal e / ou manter o equilíbrio ou auxiliar a coordenação.

- Independente: A deambulação é independente e sem supervisão ou assistência física de outra pessoa. O paciente pode utilizar dispositivos auxiliares (exceto barras paralelas), órteses e próteses.

Nível FAC	Descrição da deambulação	Definição
1	Não funcional	– Incapaz de deambular – Deambula apenas em barras paralelas – Requer supervisão ou assistência física de mais de uma pessoa
2	Dependente nível 2	– Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas para prevenir quedas – O contato manual é contínuo e necessário para suportar o peso do corpo e/ou para manter o equilíbrio ou ajudar na coordenação
3	Dependente nível 1	– Requer ajuda de uma pessoa durante a deambulação em superfícies niveladas para prevenir quedas – O contato manual é leve, contínuo ou intermitente para ajudar no equilíbrio ou na coordenação
4	Dependente, supervisão	– A deambulação ocorre em superfícies de mesmo nível sem ajuda de outra pessoa, mas por segurança, requer uma pessoa ao lado por causa do comprometimento da capacidade de decisão, status cardíaco questionável, ou da necessidade de verbalização para completar a tarefa
5	Independente apenas em superfícies de mesmo nível	– A deambulação é independente em superfícies de mesmo nível, mas requer supervisão/assistência física para deambular em escadas, inclinações ou superfícies desniveladas
6	Independente em superfícies niveladas e desniveladas	– A deambulação é independente em superfícies irregulares e niveladas, escadas e inclinações

On level 3, the second part of the first translation was: '*O contato manual é continuo ou intermitente leve para ajudar no equilíbrio ou na coordenação*' [Manual contact is a continuous or intermittent light touch to help balance or coordination]. In the final version, this was changed to '*O contato manual é leve, continuo ou intermitente para ajudar no equilíbrio ou na coordenação*' [Manual contact is a light, continuous or intermittent to help balance or coordination], which would be easier for the examiner to understand when classifying individuals who need light contact during ambulation, whether for a particular moment or throughout the entire evaluation.

In the description of level 4, the first translation was: '*A deambulação ocorre em superfícies de mesmo nível sem ajuda de outra pessoa*' [Ambulation occurs on surfaces of the same level without help from another person] and '*Requer uma pessoa do lado por causa do mau julgamento, status cardiac questionável, ou da necessidade de verbalização para completar a tarefa*' [Requires a person along-

side due to poor judgment, questionable heart status or the need for verbalization to complete the task]. In the final version, these two descriptions were united: '*A deambulação ocorre em superfície de mesmo nível sem ajuda de outra pessoa, mas, por segurança, requer uma pessoa ao lado por causa do comprometimento da capacidade de decisão, status cardiac questionável, ou da necessidade de verbalização para completar a tarefa*' [Ambulation occurs on a surface of the same level without help from another person, but, for safety, requires a person alongside due to the impairment of the decision-making capacity, questionable heart status or the need for verbalization to complete the task], as a way to facilitate the examiner's understanding and clarify that, on this level, the individual will not have contact from another person during ambulation on a level surface, but rather supervision (a person who accompanies the patient during the evaluation as a safety precaution due to a compromised decision-making capacity, questionable heart status or the need for verbalization to complete the task).

On level 5, the first translation for 'negotiating stairs' was '*subir escadas*' [going up stairs] and was changed to '*deambular em escadas*' [ambulating on stairs] in the final version, since the individual must go up and down at least seven steps.

Regarding the description of uneven ground in the user's manual of the FAC, the first translation of the word 'dirt' was '*sujeira*' [filth], but the expert panel decided that '*terra*' [unpaved ground] was more appropriate and more easily standardized for the evaluation of outdoor environments, since *sujeira* is a broad, non-specific term, whereas *terra* is easier to be reproduced.

In the cross-cultural adaptation process, the major change discussed by the expert committee regarded uneven ground, which the original version describes as grass, gravel, dirt, snow and ice. However, due to climatic and cultural characteristics in Brazil, the decision was made to standardize uneven ground using an unstable surface, such as a mat, rather than snow and ice. A mat is a low-cost instrument that is easy to handle and can be used in the clinical setting, which facilitates the administration of the FAC in routine practice and scientific research.

Intra-observer agreement for the five examiners ranged from good to excellent. Mehrholz et al [9] tested intra-observer reproducibility in a sample of 55 individuals and found excellent agreement ($\kappa = 0.95$). Inter-observer agreement among the five examiners in the present study ranged from moderate to good. In the study by Mehrholz et al [9], inter-observer reproducibility among four independent

examiners was excellent ($\kappa = 0.905$). These differences may be due to the analysis of videos for the evaluation of reliability. Although the reference for this technique was Mehrholz et al [9], it may not be the most reliable method, since it is difficult to gauge the amount of physical support the patient requires on levels 2 (manual contact is continuous to support and/or maintain balance or help coordination) and 3 (continuous or intermittent light touch to assist in balance or coordination) through video images, which may have influenced the perception of the examiners during the classification.

Mehrholz et al [9] tested predictive validity of the FAC and concluded that this scale is sensitive and specific enough to predict gait performance in the community. In the present study, a significant association was found between the classification of ambulation given by the FAC and the gait speed categories, considering the performance on the 10mWT test for the assessment of concurrent validity.

The present study demonstrates that the FAC can be used in clinical practice and research on rehabilitation for the evaluation and follow up of patients in the chronic phase of a stroke. Brief training is needed to familiarize the examiners with the scale and one should bear in mind the compensations stroke survivors can develop. Nonetheless, the FAC is a valid, reliable assessment tool for the evaluation of this specific population. The intra-examiner and inter-examiner data should be interpreted with caution considering the variations found in the reliability analysis. However, the results were acceptable.

The present findings are relevant to the field of rehabilitation, demonstrating that the translation and cross-cultural adaptation were successful, enabling the use of the FAC on the Brazilian population. Moreover, the measurement properties (reliability and validation) were similar to those found for the original English-language version of the scale. These findings contribute to the standardized use of the FAC adapted to the Brazilian population in a clinical setting.

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Traducción al portugués brasileño, adaptación transcultural, fiabilidad y validación de la *Functional Ambulation Classification* para la categorización de deambulación postictus en un entorno clínico

Introducción. La *Functional Ambulation Classification* (FAC) es la única escala que clasifica la marcha de individuos con esclerosis múltiple e ictus en categorías de deambulación. Sin embargo, la FAC sólo está disponible en la versión en inglés y los estudios realizados en Brasil la han utilizado sin una traducción y análisis adecuados de propiedades psicométricas.

Objetivo. Traducir y adaptar culturalmente la FAC para el portugués brasileño y probar su fiabilidad y validez concurrente en individuos afectados por ictus.

Pacientes y métodos. La traducción y la adaptación transcultural implicaron seis pasos. La fiabilidad interevaluador se probó con cinco fisioterapeutas que vieron vídeos de la marcha de las personas afectadas por ictus y, después de un intervalo mínimo de una semana, los vieron por segunda vez para determinar la fiabilidad intraevaluador. La validez concurrente se determinó correlacionando la FAC con el resultado de la prueba de marcha de 10 metros (PM10m).

Resultados. La fiabilidad intraevaluador varió entre un valor kappa de 0,68-0,95 (*p* = 0,001), y la fiabilidad interevaluador, un valor kappa de 0,517-0,794 (*p* = 0,001). La correlación entre la FAC y la PM10m fue r_s = 0,771 (*p* = 0,001).

Conclusión. La traducción, la adaptación transcultural y el análisis de las propiedades psicométricas demostraron que la FAC es una medida clínica válida y fiable para clasificar la deambulación de los individuos brasileños afectados por ictus en un entorno clínico.

Palabras clave. Estudios de validación. *Functional Ambulation Classification.* Ictus. Marcha. Reproducibilidad de los resultados. Traducción.