CoDAS
ISSN 2317-1782 (Online version)

Original Article
Artículo Original

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Validity and features of spontaneous speech in acute aphasia as evaluated with the Brief Aphasia Evaluation: is fluent aphasia more severe than nonfluent aphasia?

Validez y características del habla espontánea en la afasia aguda evaluada con la Evaluación Breve de la Afasia: ¿Es la afasia fluente más severa que la no fluente?

Keywords

Aphasia
Anomia
Cognition
Diagnostic Techniques and Procedures
Early Diagnosis
Psychology, Applied
Speech Language Pathology
Neuropsychiatry
Neuropsychological Tests
Validity of Tests

ABSTRACT

Purpose: To explore the relationship between the two components of spontaneous speech in the Brief Aphasia Evaluation (BAE) and the rest of the scale represented by its three main factors: The Expression, Comprehension, and Complementary factors. **Methods**: BAE has proven validity and reliability. The evaluation of spontaneous speech in this scale comprises two components: Performance Rank (score: 0-3) and Type of Disorder (Fluency [F], Content [C], or Mixed [FC]) when rank < 3. Sixty-seven patients with left brain damage and 30 demographically matched healthy participants (HP) were studied. It was analyzed the correlation between Performance Rank and the three BAE factors and, recoding 3 as 0 and < 3 as 1, the sensitivity/specificity of this component for each factor. The effect of Type of Disorder on the three factors was analyzed. **Results**: 1) Performance Rank: Correlations of 0.84 (Expression), 0.81 (Comprehension), and 0.76 (Complementary) were observed, with a sensitivity and specificity ≥ 78% for any factor; 2) Type of Disorder: The performance significantly decreased from FC to C and from C to F in Expression (FC < C < F), from FC to C and from FC to F also in Comprehension and Complementary, from patients with any type of disorder to HP. **Conclusion**: Performance Rank was a relevant indicator of aphasia by its consistency with valid and comprehensive dimensions of acute language impairments. A degree difference between F and C was observed, being F a milder disorder; i.e., fluency problems were less severe than retrieval or anomia ones.

Descriptores

Afasia
Anomia
Cognición
Pruebas Neuropsicológicas
Diagnóstico Precoz
Patología del Habla y Lenguaje
Neuropsiquiatría
Psicología Aplicada
Técnicas y Procedimientos Diagnósticos
Validez de Las Pruebas

RESUMEN

Objetivo: Explorar la relación entre los dos componentes del habla espontánea en la Evaluación Breve de la Afasia (EBA) y el resto de la escala, representada por sus tres factores principales: Expresión, Comprensión y Complementario. **Método**: EBA ha demostrado validez y confiabilidad. La evaluación del habla espontánea consta de dos componentes: Grado de Desempeño (puntuación: 0-3) y Tipo de Trastorno (Fluidez (F), Contenido (C), o Mixto (FC)) cuando grado<3. Se estudiaron 67 pacientes con lesión cerebral izquierda y 30 participantes sanos (PS), emparejados demográficamente. Se analizó la correlación entre Grado de Desempeño y los tres factores de EBA y, recodificando 3 como 0 y <3 como 1, la sensibilidad/especificidad del componente para cada factor. Se analizó el efecto de Tipo de Trastorno sobre los tres factores. **Resultados**: 1) Grado de Desempeño: Se observaron correlaciones de 0,84 (Expresión), 0,81 (Comprensión), y 0,76 (Complementario), con una sensibilidad y especificidad ≥ 78% para cualquier factor; 2) Tipo de Trastorno: El desempeño disminuyó significativamente desde FC a C y desde C a F en Expresión (FC<C<F); desde FC a C y desde FC a F también en Comprensión y Complementario; desde los pacientes con cualquier tipo de trastorno a PS. **Conclusión**: Grado de Desempeño fue un indicador relevante de la afasia por su consistencia con dimensiones válidas y comprensivas de trastornos agudos del lenguaje. Se observó una diferencia de grado entre F y C, siendo F un trastorno más leve, vale decir, los problemas de fluidez fueron menos severos que los de evocación o anomia.

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Received: March 14, 2018

Accepted: August 15, 2018

Study conducted at Consejo Nacional de Investigaciones Científicas y Técnicas de la Argentina – CONICET, Servicio de Neurología y Neurocirugía, Hospital Córdoba, Instituto de Humanidades – IDH, Universidad Nacional de Córdoba – UNC, Córdoba, Argentina.

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Financial support: the study was supported by funds from the CONICET.

Conflict of interests: nothing to declare.

INTRODUCTION

Neuropsychiatric taxonomies are mainly based on qualitative attributes and patterns, which describe complex disorders. Formulating clinical hypotheses during the first steps of the doctor-patient interview requires relying upon relevant and efficient indicators of symptoms and syndromes. Aphasia indicators are not the exception.

In the Brief Aphasia Evaluation (BAE), which has proven validity and reliability[1-5], spontaneous speech is the only item which uses a comprehensive perspective to analyze a complex behavior[6], in a similar way to that used in neuropsychiatric diagnoses.

Spontaneous speech has received considerable attention in different fields and is usually measured by tasks such as picture description, storytelling, and propositional speech, among other tasks[7-17]. Multiple language measures have been separately validated on the basis of spontaneous speech[6], but there are few studies in which spontaneous speech has been validated with several, valid and/or comprehensive language measures. In particular, there are few studies in which the aphasic components of spontaneous speech have been validated with such measures.

The present study assesses the validity and features of the item of spontaneous speech in the BAE, with regards to the specific factors of language performance assessed in the rest of the scale.

The evaluation of spontaneous speech in the BAE comprises two components: one that measures Performance Rank (scored 0-3) and another that measures Type of Disorder (Fluency [F], Content [C], or Mixed [FC]) when rank < 3. Both components are based on the professional's clinical impression on the patient's performance.

The item of spontaneous speech in the BAE:

i) has the appropriate format to be incorporated into an interview aimed at formulating clinical hypotheses, because is more comprehensive and abstract than the rest of the BAE items[6];

ii) requires special consideration because is the only item in the BAE that includes a qualitative complementary appreciation (i.e., F, C, and FC);

iii) is evaluated during the very first interview, immediately after greeting, in order to have a global idea about the patient's speech impairment;

iv) deals with only one topic of conversation, thus facilitating its assessment in patients with aphasia, who are not repeatedly frustrated with the use of several items of the same nature; and

v) is conceptually connected with the etymology definition of aphasia, which alludes to "the loss of ability to speak"[6].

Additionally, a previous study indicated that the BAE item of spontaneous speech, in its component of Performance Rank, was related to the caregiver's perception about the patient's impairment in spontaneous speech[6]. That study was carried out in a group of patients with focal brain lesions of different types and locations. Further research is needed to elucidate the meaning of this BAE item not only within the specific BAE framework, including the two components of the item, but also within the specific sample of patients with left brain damage compared with healthy participants (HP).

The research questions for this study were: What is the relevance of spontaneous speech in relation to other features of aphasia? Specifically: What does the professional's clinical impression on the patient´s spontaneous speech mean in relation to more objective factors of language performance? What does the item of spontaneous speech imply in terms of the aphasia features assessed by the BAE?

Although there are no validity studies that have examined what spontaneous speech means with regards to specific constructs of aphasia, two studies can be mentioned:

In the Western Aphasia Battery (WAB)[18], spontaneous speech is measured through the components of information content and fluency. Although the WAB authors (indirectly) provided evidence that the first component is more relevant than the second one as an index of aphasia, when the eight aphasia types of the classical taxonomy are operationally defined, only fluency is considered for classification. However, when fluent and nonfluent aphasias are operationally defined, the two components of spontaneous speech are considered:

> In assessing aphasia, evaluation of spontaneous speech, as well as more specific tasks of oral expression, is standard practice. The WAB assesses spontaneous speech for both information content and fluency characteristics; both parameters serve to differentiate fluent aphasics from nonfluent ones, since the former tend to produce copious but empty speech. Oral expression tasks are evaluated via the Repetition and Naming Subtests[18:319].

In psychometric studies of the ScreeLing test, alternatively, the whole aphasia test and its subtests of semantics, syntax, and phonology were validated on the basis of spontaneous speech[19]. Nonetheless, in this study, the assessment of spontaneous speech also included the attribute of auditory comprehension, which was practically identified with speech. So, it is not clear what spontaneous speech actually represents in relation to other features of aphasia, for example, what fluent aphasia (C in the BAE) means in terms of specific factors of language impairment. The same is true for the classification of fluent/nonfluent aphasia in the WAB[18]. In addition, the specific components of spontaneous speech were not identified and validated with the rest of the language measures assessed in the tests[18,19]; for example, F and FC were not differentiated in the WAB, and only a severity rating scale was used in the ScreeLing test.

In both studies cited here, a global clinical impression of spontaneous speech was used for final scoring, similar to the item of spontaneous speech in the BAE. In those studies, however, the selection of the patients with aphasia was also carried out by clinical impression[18,19], unlike the present study, which only included patients injured in the left hemisphere.

In the BAE design[4,5], it was assumed that the situation involved in the item of spontaneous speech and the situations involved in the rest of the items were not in principle analogous; for example, discrepancies may be observed between naming

in the spontaneous speech vs. naming by pointing at pictures (which demand different sensorial modalities and processing speeds) (see BAE Instructions[4,5:5]. Therefore, we could not anticipate a certain relationship between spontaneous speech and the rest of the BAE.

In view of the lack of clear antecedents examining the nature of the language impairments associated with spontaneous speech in acute aphasia, the objective of the present study was: To explore the relationship between both components of spontaneous speech in the BAE (i.e., Performance Rank and Type of Disorder) and the rest of the BAE represented by its three main factors (i.e., the Expression, Comprehension, and Complementary). The three BAE factors were considered potential indicators of validity for the detection of aphasia and its nature.

METHODS

Data were obtained from a sample of 97 Argentine right-handed volunteers, native Spanish speakers. Clinical data were obtained from 67 consecutive patients with focal and unilateral left cerebral lesions. The sample was recruited from the Neurological and Neurosurgery Service of the Cordoba Hospital, a public hospital for adults. Lesions were confirmed by computerized tomography (CT) scan and/or MRI techniques. None of the patients suffered from any other (previous or simultaneous) associated neurological disease. Patients who suffered from visual agnosia, who were not able to point at objects or cards, or who did not have a minimum and clear comprehension and expression of affirmative and negative answers, either verbal or nonverbal, were excluded. Control data were obtained from 30 HP who were community-dwellers, independent and adapted to daily life demands, without any known neurological or psychiatric disease. They were recruited from cultural, recreational, and retirement centers of Cordoba province. The recruitment method is better described elsewhere[1-3,6].

The two groups were matched according to gender (men's frequency: 49% [N = 48] in the total sample), years of age and education (mean [standard deviation {SD}]: 47.44 [14.62] and 8.28 [3.66], respectively, in the total sample).

For the accomplishment of this work, all the participants (or their caretakers) signed the informed consent form. This research was approved by the Research and Ethics Committee of the Cordoba Hospital (Act No. 64; 2011) and was carried out in accordance with the ethical standards established in the Declaration of Helsinki[20].

BAE is a brief, valid, and reliable aphasia scale, which has been designed to be administered by the bed of the patient. It is distributed for free in English and Spanish and has proven to be valid for detecting, from the very acute stage of the disease, not only the presence and magnitude of the aphasia, but also its components or symptoms[3]. Previous studies have demonstrated the BAE sensitivity and specificity to differentiate patients with left brain damage from both HP and patients with right brain damage[1]. The discrimination of patients injured in the verbal dominant hemisphere is the most unquestionable property of aphasia tests.

A hierarchical organization in the functions that BAE evaluates has been verified in a previous study using confirmatory factor analysis[3]. The theoretical framework proposed in such study encompassed: a) An all-inclusive verbal organizer from which the following two successive organizers emerged: b) A more general classification which essentially included Comprehension (i.e., auditory comprehension and reading) and Expression (i.e., repetition, naming, speech, and writing) followed by a "Complementary" factor which included praxia, attention, and memory; c) A more specific classification which included the individual (and correlated) constructs of auditory comprehension, repetition, naming, speech, reading, writing, as well as the "complementary" functions[3].

In the present study, the classification (b), composed by the three main BAE factors, was analyzed unless otherwise indicated. The item of spontaneous speech was analyzed separately from that classification, which represented the rest of the BAE. The item of spontaneous speech is the second one in the scale, just after the greeting, and is administered without knowing anything else about the patient. The entire BAE is administered blindly to the patient's diagnosis, neuroanatomical data, as well as to any other report about the patient.

The item of spontaneous speech explores the patients' ability to describe their own condition. The interviewer's question in this item is: "Tell me what happened to you and why you are here."

The quantity and quality of the expression is evaluated from 0 to 3, according to the following guidelines[4-6]:

The quantity of language the patient has produced (how much he/she speaks) represents fluency and has to do mainly with the articulation or linking mechanisms, that is to say, with the use of an appropriate sequence in the units of the language, (examples of alterations: the patient does not speak, uses just syllables or isolated words, telegraphic language, agrammatic speech, brief phrases, dysarthria, paraphasias [mainly phonemic], verbosity, etc.). The quality of what is expressed (what the patient speaks) has to do with the information content and the ability to retrieve words (examples of alterations: circumlocution, paraphasias [mainly semantic], "word salad", jargon, etc.). Only for screening purposes, just four categories will be considered (note: cases of disinhibition in fluency or pure verbosity are discarded; stuttering is also discarded).

Evaluation:

0 = absence of speech (in quantity or quality).

1 = severe inhibition in the quantity or distortion in the quality.

2 = slight reduction in the quantity or distortion in the quality.

3 = correct or normal speech (in quantity and quality).

Additionally, it will have to be specified whether the problem is related to production or fluency (F), to content or retrieval (C), or both (FC)[4-6]; otherwise, the code of No Abnormality Discovered (NAD) will be used.

Statistical analysis

Demographic data and/or intervening variables were analyzed by analysis of variance (ANOVA) for quantitative variables or by chi-square (chi2) for qualitative ones.

The distribution of frequencies for Performance Rank and Type of Disorder was shown, and the association between both variables was analyzed by cross-tabulation and chi2. The association when the analysis was restricted to patients (excluding HP) or when the analysis was restricted to patients with any Type of Disorder (excluding also NAD) was specially analyzed.

The Spearman's rank order coefficient (r) was calculated to see the correlation between Performance Rank and the rest of the BAE, which was evaluated in its three main factors: Comprehension, Expression, and Complementary. The median (Mdn) test was used to calculate the sensitivity and specificity for Performance Rank in the three BAE factors. With this purpose, Performance Rank was re-coded with 3 as 0 (the new value of 0 indicating lack of disorder) and < 3 as 1 (the new value of 1 indicating presence of disorder). Validity indices ≥ 70% (correlation, sensitivity, and specificity) were considered acceptable for Performance Rank.

The Kruskal-Wallis (KW) nonparametric ANOVA was used to compare the groups differentiated by Type of Disorder in order to see the effect of this variable on the three BAE factors. With the purpose of identifying the nature of the impairment, the analysis was mainly focused on pairwise comparisons between FC, C, and F, which represent the categories for patients with any Type of Disorder in spontaneous speech. The comparison between F and C was specially analyzed because FC can, in principle, be thought of as a more severe manifestation than either C or F[1].

Comparisons among all the groups (including groups without disorder) were complementarily analyzed to verify the pattern of BAE responses for Type of Disorder as a whole (note: demographic and clinical intervening variables were additionally analyzed for Type of Disorder in the group of patients [see Appendix 1, part a]; KW pairwise comparisons among all the groups on the three BAE factors were additionally analyzed in the Appendix 1, part b). In view of the exploratory nature of the study, patterns of response and statistical trends were specially examined with a descriptive purpose.

RESULTS

As shown in Table 1, patients with left brain damage and HP did not differ in their demographic data.

As shown in Table 2, a significant association between both components of spontaneous speech was observed not only when all the groups were compared, but also when either HP or NAD were excluded.

According to the Spearman's rank order coefficient, a significant and positive correlation was observed between Performance Rank and the factors of Comprehension (r = 0.81), Expression (r = 0.84), and Complementary (r = 0.76). A sensitivity of 88% (42/48) and a specificity of 86% (42/49) was observed in the Comprehension factor (chi2 = 51.99; degrees of freedom [df]: 1; $p < 0.0001$), a sensitivity of 92% (44/48) and a specificity of 90% (44/49) was observed in the Expression factor (chi2 = 64.37; df: 1; $p < 0.0001$), and a sensitivity of 85% (41/48) and a specificity of 78% (38/49) was observed in the Complementary factor (chi2 = 38.66; df: 1; $p < 0.0001$) (note: the level of precision in terms of sensitivity and specificity was ≥ 78% for all the BAE constructs or indicators [results available upon request], including subgroup of indicators, such as auditory comprehension and spoken expression [see below]).

Table 3 shows KW pairwise comparisons between F, C, and FC. As can be seen, the magnitude of the differences on the three BAE factors was successively decreasing from FC to C, and from C to F. As a consequence, the greatest difference in performance was produced between FC and F (note: excluding reading and writing from the factors of Comprehension and Expression, respectively, the difference between C and F was more evident, that is, difference in [pure] auditory comprehension: H [df = 1, N = 28] = 4.74, average ranks: C: 11.79, F: 18.68, p = 0.0294; difference in [pure] spoken expression: H [df = 1, N = 28] = 6.95, average ranks: C: 11.21, F: 19.59, p = 0.0084).

KW comparisons among all the groups (including NAD and HP) indicated a significant effect of Type of Disorder on the three BAE factors: Comprehension: H (df = 4, N = 97) = 68.01, average ranks: FC: 18.65, C: 28.97, F: 41.32, NAD: 57.63, HP: 77.93, $p < 0.0001$; Expression: H (df = 4, N = 97) = 74.73, average ranks: FC: 17.50, C: 27.41, F: 39.45, NAD: 59.45, HP: 79.12, $p < 0.0001$; Complementary: H (df = 4, N = 97) = 62.60, average ranks: FC: 20.37, C: 31.44, F: 37.09, NAD: 56.16, HP: 77.87, $p < 0.0001$. Differences among the groups in the three BAE factors were as follows: FC < C < F < NAD < HP (note: the groups of patients organized by Type of Disorder were not significantly different in the demographic and intervening variables [Table 4 of the Appendix]. Additionally, KW pairwise comparisons [Table 5 of the Appendix] indicated that, on the three BAE factors, differences between patients with any Type of Disorder and HP were highly significant [all $p < 0.0001$]. Comparisons between NAD and HP were also significant [all $p < 0.0005$]. Considering just the groups of patients, comparisons between NAD and either FC or C showed great statistical significance [all $p < 0.0003$], whereas the comparisons between F and NAD showed less significance [all $p < 0.05$]). In any case, the difference between patients with any Type of Disorder and HP was clear.

In view of the results, a degree difference along FC, C, and F was observed in the three BAE factors, being FC the most impaired and F the least impaired. In general, and given the pattern of the BAE responses as a whole, the categories for Type of Disorder were different in magnitude (not in quality) being always C an intermediate category of severity between FC and F. In particular, C showed a significant impairment with regards to F in expression (total expression and spoken expression), as well as in auditory comprehension.

[1] A difference between C and F (with $p < 0.05$) for Type of Disorder was considered significant because it was the main and newest comparison for this component (i.e., apart from FC (see above), significant differences between F and HP or between C and HP were also expected).

Table 1. Demographic data

GROUP	Age (years)	Education (years)	Gender (men's frequency)	N
Patients	47.24 SD 14.88	8.18 SD 4.03	34	67
HP	47.90 SD 14.26	8.50 SD 2.70	14	30
	F(1,95)=0.04	F(1,95)=0.16	chi2=0.14; df: 1	
	p=0.84	p=0.69	p=0.71	

Caption: GROUP: patients with left brain damage (Patients) and matched healthy participants (HP); N: number of cases per group; SD: standard deviation; F(1,95): F-statistics with degrees of freedom; chi2: chi-square statistics; df: degrees of freedom; p: p-value

Table 2. Distribution of frequencies for Performance Rank and Type of Disorder in the Brief Aphasia Evaluation (BAE) item of spontaneous speech

GROUP	PERFORMANCE RANK				N
	0	1	2	3	
FC	10	7	3	0	20
C	2	7	8	0	17
F	0	4	7	0	11
NAD	0	0	0	19	19
HP	0	0	0	30	30
Total	12	18	18	49	97
	chi2=125.61, df=12, p<0.0001				

Caption: N: number of cases per group; GROUP: Patients with any Type of Disorder (Mixed [FC], Content [C], or Fluency [F]); patients with No Abnormality Discovered (NAD); and Healthy Participants (HP). By excluding HP: chi-square (chi2) = 86.76, degrees of freedom (df) = 9, p < 0.0001. By excluding HP and NAD: chi2 =14.16, df = 4, p = 0.0068. Patients had left brain damage

Table 3. Differences between patients with any Type of Disorder (Fluency [F], Content [C], or Mixed [FC]) on the three main Brief Aphasia Evaluation (BAE) factors, according to the Kruskal-Wallis test

Between-group comparison	Average ranks		H (df = 1)	p-value
FC and C (N = 37)	FC (N=20)	C (N=17)		
Comprehension factor	15.10	23.58	5.65	0.017
Expression factor	15.20	23.47	5.37	0.020
Complementary factor	14.82	23.91	6.56	0.010
C and F (N = 28)	C (N=17)	F (N=11)		
Comprehension factor	12.32	17.86	3.03	0.082
Expression factor	11.82	18.64	4.58	0.032
Complementary factor	13.53	16.00	0.60	0.436
FC and F (N = 31)	FC (N=20)	F (N=11)		
Comprehension factor	12.65	22.09	7.65	0.006
Expression factor	12.25	22.82	9.59	0.002
Complementary factor	13.25	21.00	6.26	0.022

Significant differences were as follows: FC < C < F in Expression (i.e., the least significant difference was C versus F in Expression); FC < C and FC < F also in Comprehension and Complementary. H: Kruskal-Wallis statistics; N: number of cases per group; df: degrees of freedom

Table 4. Type of Disorder: demographic data and risk factors in patients with left brain damage

GROUP	Age (years)	Education (years)	Gender (men's frequency)	Risks factors (number)	N
FC	52.45 SD 15.64	7.35 SD 4.18	11	2.15 SD 1.50	20
C	49.94 SD 10.95	8.41 SD 3.61	9	2.29 SD 1.69	17
F	45.54 SD 15.34	7.45 SD 2.87	6	1.73 SD 1.68	11
NAD	42.42 SD 15.58	9.26 SD 4.76	8	1.26 SD 1.48	19
Total	47.84 SD 14.77	8.18 SD 4.03	34	1.87 SD 1.59	67
	F(3,63)=1.76	F(3,63)=0.87	chi2=0.81; df: 3	F(3,63)=1.59	
	p<0.16	p<0.46	p<0.85	p<0.20	

Caption: GROUP: Patients with any Type of Disorder (Mixed [FC], Content [C], or Fluency [F]) and patients with No Abnormality Discovered (NAD). N: number of cases per group; SD: standard deviation; F(3,63): F-statistics with degrees of freedom; chi2: chi-square statistics; df: degrees of freedom; p: p-value

Table 5. Differences between patients with any Type of Disorder, HP, and NAD on the three main Brief Aphasia Evaluation (BAE) factors according to the Kruskal-Wallis test

Between-group comparison	Average ranks		H (df = 1)	p-value <
FC and HP (N = 50)	FC (N=20)	HP (N=30)		
Comprehension factor	10.62	35.42	38.45	0.0001
Expression factor	10.50	35,50	38.59	0.0001
Complementary factor	11.50	34.83	32.13	0.0001
C and HP (N = 47)	C (N=17)	HP (N=30)		
Comprehension factor	9.00	32.50	36.10	0.0001
Expression factor	9.00	32.50	35.52	0.0001
Complementary factor	9.53	32.20	31.19	0.0001
F and HP (N = 41)	F (N=11)	HP (N=30)		
Comprehension factor	8.04	25.75	22.00	0.0001
Expression factor	6.18	26.43	27.20	0.0001
Complementary factor	7.41	25.98	20.92	0.0001
NAD and HP (N = 49)	NAD (N=19)	HP (N=30)		
Comprehension factor	15.89	30.77	15.51	0.0005
Expression factor	15.24	31.18	17.04	0.0002
Complementary factor	14.97	31.35	16.14	0.0002
FC and NAD (N = 39)	FC (N=20)	NAD (N=19)		
Comprehension factor	11.77	28.66	21.44	0.0001
Expression factor	11.05	29.42	25.33	0.0001
Complementary factor	12.30	28.11	18.88	0.0001
C and NAD (N = 36)	C (N=17)	NAD (N=19)		
Comprehension factor	11.06	25.16	16.13	0.0002
Expression factor	10.12	26.00	20.42	0.0001
Complementary factor	11.47	24.79	14.42	0.0003
F and NAD (N = 30)	F (N=11)	NAD (N=19)		
Comprehension factor	11.32	17.92	3.96	0.0468
Expression factor	9.82	18.79	7.25	0.0072
Complementary factor	10.68	18.29	5.25	0.0221

Caption: Patients with any Type of Disorder (Mixed [FC], Content [C], or Fluency [F]); patients with No Abnormality Discovered (NAD); and Healthy Participants (HP). H: Kruskal-Wallis statistics; N: number of cases per group; df: degrees of freedom

DISCUSSION

Several measures of spontaneous speech have been proposed to assess the ability of communication in patients with aphasia (see, e.g.[18,19,21-23]). Failures of content (C) and fluency (F) are usually considered (*a priori*) separate and key constructs to identify qualitative different aphasia syndromes (see, e.g.[18,24]).

In the present study, the Type of Disorder observed in patients with left brain damage during spontaneous speech was mainly assessed by C and F. Within this framework, it was expected that patients with a mixed disorder (FC) had a more severe impairment in verbal expression than those patients with just one type of disorder, either F or C. But it was not so expected that C had a more severe impairment than F. Theoretically speaking, and only considering verbal expression, if C is worse than F in the quality of speech and F is worse than C in the quantity of speech, and C and F are both mutually exclusive and equally important indicators of expression, then the presence of either C or F should produce similar impairment in the final balance of verbal expression; but that was not the case. C showed a worse performance than F in naming, repetition, speech, and writing, which represent the BAE expression factor. As a result, C and F did not seem to act like mutually exclusive (qualitative) types of language disorders, but rather as two steps of the same underlying process, which was probably related to severity. In this case, a degree difference between C and F was observed in verbal expression, being F a milder disorder. In other words, fluency problems were less severe than retrieval or anomia ones.

In the WAB[18], information content and fluency showed a high correlation with each other (0.79) and these two components of spontaneous speech showed a high correlations with both naming (above 0.77) and repetition (above 0.70)[2]. Those results are consistent with the present findings, because naming and repetition represented oral expression in the WAB and they also were part of oral (spoken) expression in the BAE expression factor. Moreover, when writing was excluded from the expression factor in the BAE, the severity of C regarding F was more evident. Similarly, and even though C and F showed similar impairments in the BAE comprehension and complementary factors, when reading was excluded from the BAE comprehension factor, the difference of C regarding F

[2] Naming and repetition in the WAB[18] also showed a high correlation with each other (0.85).

became significant. Coincidently, in the WAB[18], information content was more related to auditory comprehension than fluency (i.e., the correlation of auditory comprehension with information content was 0.73 and with fluency was 0.51). Therefore, it is probable that failures of content are more severe than failures of fluency because failures of content are more related to auditory comprehension, and impairments in auditory comprehension are usually associated with more severe forms of aphasia (see, for example, global aphasia or isolation [transcortical mixed] aphasia in the WAB[18]).

Closely related to the above mentioned, information content in the WAB was more relevant than fluency as an index of aphasia[3] (i.e., from a total of nine subtests of the WAB, the correlations of information content with the rest of subtests was always above 0.73, except for three subtests, whereas the correlations of fluency with the rest of subtests was always below 0.6, except for two subtests[18] [see also above repetition and naming]). Information content and fluency in the WAB are indicators of fluent and nonfluent aphasias, which at once are considered two different aphasia types[18]. Yet, present findings with C and F in the BAE support the hypothesis that C (fluent aphasia) is more severe than F (nonfluent aphasia) because C showed a more severe impairment than F in the expression factor. In addition, since this effect was more evident when writing was excluded, it can be stated that this effect was probably due to the specific assessment of spoken expression during spontaneous speech.

Fluency is frequently considered as the first step to categorize aphasia syndromes when it would be better to leave this step to auditory comprehension or comprehension in general, which are related to more serious cognitive deficits[6,18] and also comprise more areas of the brain[10,11]. Although the quantity of speech may be easier to perceive for the listener than the quality of speech, particularly during spontaneous speech, that is not a reason to put fluency in first place for diagnosing or for categorizing aphasia syndromes.

Since the level of the severity is associated with both the number of symptoms and their relevance, determining such relevance must be a subject of research[4].

In this exploratory study, considering only the apparent impairment in spontaneous speech, fluency was less relevant as an aphasia symptom than information content, which was more related to comprehension and, for this reason, probably processed as a priority during the course of spontaneous speech.

Drawing a parallel between the process of speech production and the process of language evolution, the process of comprehension is usually seen as a priority in relation to the process of expression and, within the latter, the process of producing meaningful utterances is usually seen as a priority in relation to the process of forming words and sentences in an articulate way. For example, toddlers are typically able to understand words before they can use them, however, with the mastery of the grammar of the language and with the development of multiword utterances, toddlers' language also includes an increasing number of adjectives, as well as a growing number of function words[25]. Several researchers have established that toddlers tend to speak open-class or content words such as nouns, verbs and adjectives earlier than closed-class or grammatical words such as prepositions, determiners, and pronouns[25].

If this is the case, i.e., if the relevance of the language skill is determined according to its significance to human evolution, it is likely that, within expression or, specifically, within the spontaneous spoken expression, the content of the information be more relevant than the form of the expression, which is consistent with what was found here. That is why a patient who does not show failures in the speech-information content can speak very few words and be perfectly understood. From a different perspective, this could mean that the lexical-semantic aspects of communication are prioritized over the morphological and syntactic ones, in particular, if comprehension is preserved.

Present results partially agree with the psychometric studies of the ScreeLing test, in which patients with a selective phonological disorder had the highest spontaneous speech ratings.

Apart from the above mentioned regarding the component of Type of Disorder, the component of Performance Rank demonstrated to be a relevant indicator of aphasia, by its consistency with valid and comprehensive dimensions of acute language impairments: Correlations above 0.75 were observed for the Expression, Comprehension and Complementary BAE factors and the level of precision in terms of sensitivity and specificity (according to the median) was $\geq 78\%$. To be more specific, the sensitivity and specificity was $\geq 78\%$ not only for all the BAE factors, but also for all the BAE constructs or indicators, including subgroup of indicators, such as auditory comprehension and spoken expression.

These results agree with some validity studies which consider that the severity of impairment is more relevant than the type of aphasia (see[1]). Moreover, a general and dominant verbal language dimension, mainly associated to severity of impairment, has also been recognized in the WAB, being the two WAB components of spontaneous speech included in such index[18]. Considering prospective aphasia studies, the severity of the initial symptoms is also recognized as predictor of recovery[26-28]. Thus, even if the Type of Disorder is taken into account during spontaneous speech for diagnosis, the relevance of such a disorder appears to be related to the severity of the aphasia impairment.

Similarly to the results obtained here with Performance Rank, it was recently observed that a quantitative measure of spontaneous speech and formal aphasia testing detected comparable language impairments[29]. Although formal testing remains overall the better option for assessment, spontaneous speech may provide a viable alternative when there are restrictions on testing time or when the patient is too tired to undergo formal testing[29].

The component of Performance Rank in the BAE item of spontaneous speech is scored from 0 to 3 in the same way that other screening scales of the laboratory, which have proven validity using four-point scoring[6,17,30]. So, it is probable that

[3] It is worth noting, that the specific components of spontaneous speech were not directly and explicitly assessed by the WAB authors in relation to the rest of the language measures assessed in the test. For that reason, the pertinent figures, along with their interpretations, are deduced and emphasized here.

[4] In passing, if an algorithm is used to classify the syndromes according to type and severity, the sequence of categorization is also a variable of influence, i.e., not only the number and relevance, but also the order of the symptoms successively analyzed will be related to the final classification.

for certain psychological attributes the patient's impairment can be categorically and legitimately screened, as long as the conditions of evaluation (and the nature of the attribute) justify doing it. Additionally, since a previous study with the BAE indicated that the item of spontaneous speech, in its component of Performance Rank, was related to the caregiver's perception about the patient's impairment in spontaneous speech[6], the validity of present results is strengthened.

CONCLUSION

Present results demonstrate that the item of spontaneous speech in the BAE, particularly in its component of Performance Rank, is a valid (and efficient) measure to detect aphasia and can be used as screening to early formulate a clinical hypothesis on the condition, especially on the aphasia severity. Considering the component of Type of Disorder, present results suggest that the quantity (F) and quality (C) of speech in acute aphasia are difficult to be separated: both lack of fluency (F) and lack of information content (C), as interpreted by the professional, were objectively related to impairment in the BAE expression factor showing C (fluent aphasia) a more severe impairment than F (nonfluent aphasia); that was so even observing similar impairment in the BAE comprehension and complementary factors. In other words, failures of fluency and content did not seem to act like mutually exclusive (qualitative) types of language disorders, but rather as a unified construct, particularly in the expressive language. The quantity and quality of impairment in spontaneous speech were related to the BAE expression factor as well as to the (more fine-grained) features of spoken expression and auditory comprehension. In any case, a degree difference between F and C was observed, being F a milder disorder.

Current exploratory findings are encouraging because there is little research in neuropsychiatry specifically addressed to determine the implications of spontaneous speech impairments on the acute aphasia features with an *a posteriori* approach, in particular with the use of categorical scales for the assessment of those impairments. Further research is needed to prove these trends.

ACKNOWLEDGEMENTS

I thank the participating institutions and professionals who collaborated so that this research could be carried out.

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Author contributions

NSV is responsible for the idealization of the study, data collection, analysis and interpretation, and article writing. Note: The lesion diagnosis and neuroanatomical data were made by the neurosurgery team of the Córdoba Hospital and supervised by the Head of Service, Dr. Francisco Roque Papalini.

Appendix 1. Type of Disorder

a) Demographic data and intervening variables in the group of patients

The groups of patients were compared on their demographic variables, risk factors (malnutrition, frequent contact with toxic agents, hypertension, heart disease, obesity, diabetes, genetic component of the illness, alcohol or drug consumption, etc.), type and site of lesion, as well as on disease duration. As Table 4 shows, there were no significant differences among groups on the demographic variables, as well as on risk factors. There were no significant differences among groups on the site of lesion (anterior [frontal]: FC = 7, C = 3, F = 3, NAD = 5, posterior [temporal, parietal, or occipital]: FC = 3, C = 6, F = 2, NAD = 9, antero-posterior: FC = 7, C = 6, F = 6, NAD = 5, and subcortical: FC = 3, C = 2, F = 0, NAD = 0 [chi2 = 10.88; df: 9; p = 0.28]). Considering the type of the lesion, the difference between malignant tumors and the rest of the lesions was not significant (frequency of malignant tumors: FC = 9, C = 9, F = 6, and NAD = 9; chi2 = 0.04; df: 3; p = 0.99) (note: nonsignificant differences were observed among groups when specific type of lesions [arteriovenous malformation, ischemic stroke, mesial temporal sclerosis, traumatic brain injury, etc.] were compared [chi2 = 23.86; df: 27; p = 0.64], or even when specific lobe lesions [temporal, parietal, temporo-parietal, temporo-occipital, etc.] were compared [chi2 = 22.88; df: 21; p = 0.35]; differences on disease duration [$F(3,63) = 0.87$, $p < 0.46$] were not significant either [figures not shown, but available upon request]).

b) Additional comparisons among all the groups (Table 5)