Predictors of functional communication in people with aphasia after stroke

Preditores de comunicação funcional em pessoas com afasia após acidente vascular cerebral

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Abstract

Background Aphasia, the most common language disorder secondary to stroke, has been associated with increased mortality, longer hospitalization and rehabilitation times, worse performance in daily activities, increased financial burden, and short- and long-term complications. Aphasia can negatively impact functional communication skills, including social networks, social activities, relationships with other people and social support.

Objective To evaluate patients with poststroke aphasia in their respective residences to investigate potential predictors of functional communication.

Methods The prospective cohort included patients with poststroke aphasia aged 18 years or older who resided in the city of Salvador, Northeastern Brazil. Following discharge from the Stroke Unit (SU), the individuals themselves, or their guardians, were contacted by telephone to schedule a home visit no less than three months after discharge. At baseline, sociodemographic and clinical data were collected, in addition to the scores on the National Institutes of Health Stroke Scale (NIHSS) and modified Barthel Index (mBI). The American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (ASHA FACS) was applied at the patients' homes. Multivariate linear regression was employed using the total score on the ASHA FACS as the outcome of interest.

Results A multivariate analysis of the associated factors identified using the linear regression revealed that only functional capacity (as assessed by the mBI) upon discharge from the SU remained as an independent predictor of functional

Keywords
- Stroke
- Aphasia
- Communication
- Community Integration

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communication performance (β = 0.042; 95% confidence interval [95%CI] = 0.013–0.071; $p = 0.002$).

Conclusion The functional capacity to perform daily activities, evaluated upon discharge from a stroke unit, was identified as a potential predictor of functional communication performance, regardless of the time elapsed after the stroke.

Resumo

Antecedentes A afasia, distúrbio de linguagem mais comum secundário ao acidente vascular cerebral (AVC), está associada ao aumento da mortalidade, a um maior tempo de internação e reabilitação, ao pior desempenho nas atividades diárias, ao aumento da carga financeira, e às complicações de curto e longo prazos. Pode impactar negativamente as habilidades de comunicação funcional, incluindo atividades sociais, relacionamento com outras pessoas, e o apoio social.

Objetivo Avaliar pacientes com afasia pós-AVC em suas respectivas residências para investigar potenciais preditores de comunicação funcional.

Métodos A coorte prospectiva incluiu pacientes com afasia pós-AVC com 18 anos de idade ou mais, residentes em Salvador, Brasil. Após a alta da Unidade de AVC (UAVC), os próprios indivíduos, ou seus responsáveis, foram contatados por telefone para agendamento de visita domiciliar no mínimo três meses após a alta. Inicialmente, foram coletados dados sociodemográficos e clínicos, além das pontuações na National Institutes of Health Stroke Scale (NIHSS) e no Índice de Barthel modificado (IBM). O American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (ASHA FACS) foi aplicado no domicílio dos pacientes. A regressão linear multivariada foi empregada usando a pontuação total no ASHA FACS como o desfecho de interesse.

Palavras-chave
- Acidente Vascular Cerebral
- Afasia
- Comunicação
- Integração à Comunidade

Resultados A análise multivariada por meio de regressão linear revelou que apenas a capacidade funcional avaliada na alta da UAVC permaneceu como preditor independente do desempenho da comunicação funcional (β = 0,042; intervalo de confiança de 95% [IC95%] = 0,013–0,071; $p = 0,002$).

Conclusão A capacidade funcional para realizar as atividades diárias, avaliada na alta hospitalar, foi identificada como potencial preditor do desempenho da comunicação funcional, independente do tempo desde o AVC.

INTRODUCTION

Aphasia, the most common language disorder secondary to stroke, has been associated[1] with increased mortality, longer hospitalization and rehabilitation times, worse performance in daily activities, increased financial burden, and short- and long-term complications. This condition has been shown[2] to compromise functional recovery and the social reintegration of affected individuals.

People with aphasia present alterations in the content, form and use of language, which manifest both in the expression and interpretive aspects of their abilities, and can range from partial to complete impairment.[3] Along with the linguistic components of communication, other domains, such as attention, memory, executive function, and visuospatial abilities may be affected,[4] in addition to emotional aspects.[5] Aphasia can negatively impact functional communication skills, including the social networks, social activities, relationships with other people, and social support.[6]

Studies[7,8] on early recovery and functional reorganization have considered distinct prognostic factors that may influence the course of long-term recovery in people with aphasia. The lack of concordant data in the literature may be due to the heterogenous characteristics of the studied individuals, as well as the methodology employed, which could significantly influence the patterns of communicative recovery poststroke.[8] Researchers[9] have acknowledged difficulties in predicting recovery outcomes in study populations, especially due to the classification of the severity of the aphasia of the included individuals. Sociodemographic factors and others related to education and income, as well as stroke severity, can play crucial roles in the readaptation of the individuals to their domiciles and functional communication.[10,11]

Different studies[9,12] have sought to expand the scope of the investigation into the identification of predictors of recovery, in distinct poststroke phases and contexts in people with aphasia. Data[12–15] has indicated that functional

communication performance in these persons is not only linked to stroke severity, but is also dependent on the characteristics of the individuals, their previous linguistic abilities, occupation, cultural interests, and level of schooling. Functional communication is considered the ability to express and interpret messages, and to communicate effectively and independently in conformance with the environmental context.[16] To provide greater insight beyond linguistic behavior, the American Speech-Language-Hearing Association Functional Assessment of Communication Skills for Adults (ASHA FACS)[17,18] was developed to expand the capacity to evaluate communicative abilities in each individual's respective environment, providing information on their ability to perform basic daily communication tasks, considering compensative measures, adaptations, and the time required to communicate.

In an effort to amplify our understanding with regard to the impacts of aphasia and enhance the precision in prognosis and intervention measures designed to improve communication performance in people with aphasia after stroke, the most affected communication abilities have been documented,[19] and potential indicators of communication recovery have been investigated.[7,12,13] Considering that few investigations[20–23] have focused on functional communication abilities developed by these patients in their natural environment, the present study aimed to evaluate people with aphasia after stroke in this context to identify potential predictors that could influence the performance of functional communication.

METHODS

Design

The present study employed a prospective cohort developed as part of a previous study.[24]

Participants

The present study included individuals aged 8 years or older who received a diagnosis of ischemic stroke confirmed by neuroimaging (computed tomography or magnetic resonance imaging) and resided in the city of Salvador (state of Bahia, Northeastern Brazil). Following discharge from the Stroke Unit (SU) of a public hospital, the individuals themselves, or their guardians, were contacted to schedule a home visit no less than three months after discharge. At each visitation, a speech-language therapist (SLT) conducted clinical assessments of language function to confirm the diagnosis of aphasia. Deceased individuals and those who experienced a new episode of stroke were excluded.

Data collection procedures

Baseline data was obtained from a previous prospective cohort study.[24] Further data collection was performed via in-home visitations no less than three months after discharge, scheduled by telephone according to each participant's home address for purposes of optimization. The visitations took place between September 2016 and May 2018, involving an SLT and a physiotherapist who were both specialists in neurorehabilitation. The present research protocol was approved by the Institutional Review Board, and all participants or guardians signed a informed consent form.

Collection instruments and definition of variables during hospitalization

The sociodemographic data was comprised of age, sex, level of schooling, self-reported skin color (which, for the purpose of analysis, was summarized as white/non-white), marital status (married or unmarried), family income, expressed in terms of multiples of monthly minimum wage (1 monthly minimum wage = R$ 954; roughly US$ 250). Additional data parameters included current smoking habit and alcohol consumption.

The clinical characteristics of the stroke event were described in accordance with involvement of the left middle cerebral artery, hemorrhagic transformation, previous occurrence of stroke, and thrombolytic treatment. The severity of the stroke was measured at the SU using the National Institutes of Health Stroke Scale (NIHSS),[25] with higher scores indicating greater severity (range: 0–42). Individuals who presented language impairment according to item 9 of the NIHSS were considered aphasic and marked for follow-up by an SLT during the in-home visitations.

The length of hospitalization was defined in accordance with the number of days in the SU. The following comorbidities were considered in the medical records: hypertension (HTN), diabetes mellitus (DM), hypercholesterolemia, atrial fibrillation (AF), and other cardiopathies. The modified Barthel Index (mBI) was used to assess functional capacity in daily activities upon hospital discharge.

The results were categorized into functionality groups: 50–total independence; 46 to 49–slightly dependent; 31 to 45–moderate dependence; 11 to 30–important dependence; and 0 to 10–total dependence.[25]

Collection instruments and definition of variables during home visits

The patients identified with language impairment during hospitalization were subsequently evaluated by an SLT in their homes. The functional diagnosis of aphasia involved clinical assessments of language, including spontaneous speech (directed and non-directed), auditory and written comprehension, repetition, reading, and writing.[26]

To evaluate the functional communication in aphasic individuals, the ASHA FACS,[24] an instrument to assess verbal, written and non-verbal expression skills, numerical concepts, and the necessary comprehension for efficient communication, was applied. It consists of 43 questions divided into 4 domains: Social Communication; Communication of Basic Needs; Reading, Writing, and Number Concepts; and Daily Planning. The ASHA FACS is used to obtain parameters related to communicative activities in persons with difficulties in functional communication. The version of this instrument validated in Brazil was applied by the SLT at each patient's home, considering colleted information from the individual, or relative or caregiver.[27]

The maximum possible score on the ASHA FACS is 7, which indicates that a patient is totally independent with regard to communicative behavior; 6 indicates the patient requires assistance in rare cases; 5, that the patient occasionally needs assistance; 4 indicates that an individual often requires assistance; 3, that the patient very frequently needs assistance; 2, that the patient requires continual assistance to perform a communicative behavior; and 1, that the patient is not able to perform any communicative activity.[28,29]

Statistical analysis

In the descriptive analysis, the numerical variables were expressed as means and standard deviations or medians and interquartile ranges (IQRs), while the categorical variables were expressed as absolute and relative frequencies.

Univariate analysis using linear regression was applied to assess the influence of the variables identified in the literature and clinical practice (such as age, sex, level of schooling, stroke severity, time elapsed since the stroke, poststroke functional capacity, marital status, previous stroke event, and other clinical aspects) on the outcome of interest, the total score on the ASHA FACS.

Variables indicating associations with functional communication in the univariate analysis ($p < 0.10$), as well as the vascular territory of the lesion, were inserted into a multivariate linear regression model. The results of the regression model were expressed using the β coefficient and the respective confidence intervals.

RESULTS

From a total of 204 individuals evaluated between January 2015 and June 2016, 81 people with aphasia were identified. Of these, 38 were excluded (14 had died, 13 were lost to follow-up, 7 presented new episodes of stroke, and 4 refused to take part in the research). Thus, 43 individuals were subsequently visited by the research team in their homes following discharge from the SU. After discharge, 12 individuals (27.9%) underwent speech therapy and 11 (25.6%) underwent physical therapy. We found that only 4 individuals (9.3%) continued to perform their work activities.

►**Table 1** details the characterization of the sample: 26 (60.5%) were female patients with a median (IQR) age of 66 years (range: 57 to 70 years); 35 (81.4%) self-reported their skin color as non-white, and 22 (51.2%) were married or in a stable relationship. the median (IQR) years of schooling were 5 (range: 4 to 12 years), and the median (IQR) family income was 2 (range: 1 to 2) monthly minimum wages.

The most prevalent comorbidity identified was HTN 32 (74.4%), followed by DM 18 (41.9%) and other cardiopathies 11 (25.6%). Regarding lifestyle habits prior to the stroke event, 7 (16.3%) reported consumption of alcoholic

Table 1 Sociodemographic, clinical and functional characteristics of the study sample

Age at time of admission to the Stroke Unit: median (IQR)		66 (57–70)
Females: n (%)		26 (60.5)
Non-white skin color: n (%)		35 (81.4)
Married or in a stable relationship: n (%)		22 (51.2)
Years of schooling: median (IQR)		5 (4–12)
Family income*: median (IQR)		1 (1–2)
Alcohol consumption: n (%)		7 (16.3)
Current smoking habit: n (%)		6 (14.0)
Previous stroke: n (%)		13 (30.2)
Comorbidities	Systemic arterial hypertension: n (%)	32 (74.4)
	Diabetes mellitus: n (%)	18 (41.9)
	Obesity: n (%)	5 (11.6)
	Hypercholesterolemia: n (%)	3 (7.0)
	Atrial fibrillation: n (%)	7 (16.3)
	Other cardiopathies: n (%)	11 (25.6)
Stroke severity (NIHSS): median (IQR)		12 (5–19)
Left middle cerebral artery involvement: n (%)		33 (76.7)
Hemorrhagic transformation: n (%)		5 (11.6)
Thrombolytic treatment: n (%)		18 (41.9)
Length of stay in Stroke Unit in days: mean (SD)		8.7 (±4.3)
Functional capacity (mBI) score upon discharge from the Stroke Unit: median (IQR)		46 (26–50)

Abbreviations: IQR, interquartile range; NIHSS, National Institutes of Health Stroke Scale; mBI, modified Barthel Index; SD, standard deviation.
Note: *Family income expressed as the number of monthly minimum wages in Brazilian Reais (1 minimum wage is roughly US$ 200).

beverages, and 6 (14.0%) were current smokers. Prevoious stroke event was reported by 13 (30.2%), and 33 (76.7%) presented involvement of the left middle cerebral artery. The median (IQR) NIHSS score was of 12 (range: 5 to 19), indicating moderate to serious neurological impairment. The average length of stay in the SU was of 8.7 days (± 4.3 days), and 41.9% (18/43) of the patients had been submitted to thrombolytic treatment. Upon discharge from the SU, functional capacity assessments by mBI presented a median score (IQR) of 46 (range: 26 to 50), classified as slightly dependent.

Following discharge from the SU, the patients were assessed in their homes, and the mean time since the stroke was of 18.6 (± 6.0) months. The average score on the ASHA FACS was 4.9 (range: 3.8 to 5.9), indicating a patient's need for very frequent to occasional assistance. When analyzed by domain, the median (IQR) of the Communication of Basic Needs domain was 6.7 (range: 6.0 to 7.0), suggesting that the patients rarely needed assistance, or were totally independent, in this domain. The median (IQR) of the Social Communication domain was 6.4 (4.6 to 6.9), revealing that individuals needed minimal assistance or were almost independent. However, the median (IQR) of the Reading, Writing, and Number Concepts domain was 3.8 (2.0 to 5.6), indicating the need for very frequent assistance, and the median (IQR) of the Daily Planning domain was 3.4 (1.8 to 4.8), suggesting that patients needed frequent assistance in this domain (►**Figure 1**).

►**Table 2** details the factors identified in the univariate analysis as associated with functional communication performance. Linear regression was performed considering the total score on the ASHA FACS as the outcome of interest. The following variables were identified as associated with functional communication: level of schooling ($\beta = 0.111$; 95% confidence interval [95%CI] = 0.025 to 0.196; $p = 0.012$), family income ($\beta = 0.249$; 95%CI = 0.29 to 0.468; $p = 0.027$), and functional capacity (according to the mBI) upon discharge from the SU ($\beta = 0.055$; 95%CI = 0.025 to 0.85; $p = 0.001$).

The subsequent multivariate analysis of the results identified using linear regression revealed that only functional capacity (according to the mBI) after discharge from the SU remained as an independent predictor of functional communication ability ($\beta = 0.042$; 95%CI = 0.013 to 0.071; $p = 0.002$) (►**Table 3**).

DISCUSSION

The present study found that functional communication in patients with aphasia investigated in a previous cohort study[24] was associated with functional capacity in the performance of daily activities, as evaluated upon discharge from a severe SU. Data in the literature indicate that aphasia is strongly associated with functional capacity in multiple aspects,[1,30] which impacts the performance of daily activities,[31] as well as an individual's home integration and social reintegration.[2,32] In line with our results, another study[12] also showed that the results on the mBI enabled the prediction of the functional impacts of aphasia in individuals after a stroke.

Previous studies[30,33] that sought to investigate the relationship between aphasia and motor performance reported that the discordant results obtained need further investigation. An intensive neurorehabilitation program in people with aphasia resulted in functional improvement in some aspects, such as, ambulation (chair/bed transfer abilities); however little improvement was observed in terms of daily care activities, such as bathing, dressing, using the bathroom,

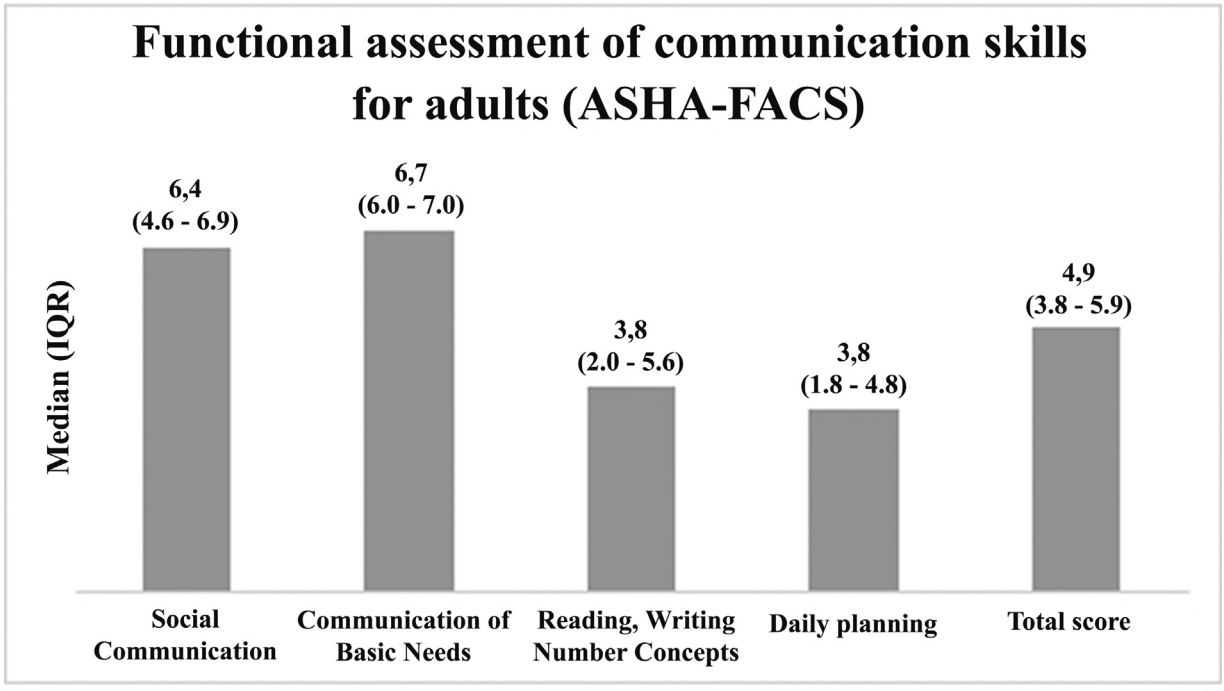

Figure 1 Distribution of ASHA FACS domain scores among the study sample.

Table 2 Univariate linear regression analysis of factors associated with functional communication in poststroke aphasic individuals

Variable	β (95%CI)	*p*
Age at time of admission to the Stroke Unit	-0.011 (-0.45–0.22)	0.508
Level of schooling (in years)	0.111 (0.025–0.196)	0.012
Family income	0.249 (0.29–0.468)	0.027
Stroke severity (NIHSS)	-0.012 (-0.081–0.057)	0.730
Length of hospitalization at the Stroke Unit (in days)	-0.003 (-0.113–0.106)	0.952
Time since stroke (in months)	0.035 (-0.043–0.113)	0.317
Functional capacity (mBI) upon discharge from the Stroke Unit	0.055 (0.025–0.85)	0.001
Female sex	-0.161 (-1.107–0.789)	0.733
Non-white skin color	-0.149 (-1.339–1.041)	0.801
Married or in a stable relationship	0.020 (-0.907–0.948)	0.965
Previous stroke	-0.803 (-1.780–0.174)	0.105
Left middle cerebral artery involvement	-0.923 (-1.981 - 0.135)	0.085
Hemorrhagic transformation	0.343 (-1.098 - 1.785)	0.633
Thrombolytic treatment	0.516 (-0.410 - 1.441)	0.267
Actively employed poststroke	1.203 (-0.346 - 2.753)	0.125
Active employment prior to thr stroke event	-0.436 (-1.524 - 0.652)	0.423

Abbreviations: 95%CI, 95% confidence interval; NIHSS, National Institutes of Health Stroke Scale; mBI, modified Barthel Index.
Note: *Family income expressed as the number of monthly minimum wages in Brazilian Reais (1 minimum wage is roughly US$ 200).

Table 3 Multivariate linear regression analysis of predictor of functional communication in poststroke aphasic individuals

Variable	β (95%CI)	*p*
Level of schooling (in years)	0.071 (-0.005–0.146)	0.060
Family income	0.118 (-0.076–0.312)	0.221
Left middle cerebral artery involvement	-0.582 (-1.455–0.291)	0.253
Functional capacity (mBI) score upon discharge from the Stroke Unit	0.042 (0.013–0.071)	0.002

Abbreviations: 95%CI, 95% confidence interval; mBI, modified Barthel Index.
Note: *Family income expressed as the number of monthly minimum wages in Brazilian Reais (1 minimum wage is roughly US$ 200). R^2 0.388.

as well as climbing stairs.[30] This provides evidence of the complexity of these activities, which are not only associated with alterations in the motor ability of the limbs and trunk, but also imply cognitive demands[32,33] related to the planning and control of actions involved in complex motor sequences, mainly those pertaining to the upper right limb, which is more commonly used in the performance of daily activities by right-handed individuals.[34,35] Although the present study did not attempt to stratify the performance of activities in each of the mBI domains, we did observe that the communicative performance of the included individuals was more efficient in the execution of more concrete or simple tasks than in those requiring additional linguistic components and abstract reasoning.[36]

Our analysis of functional communication results distributed across the ASHA FACS domains indicate that the studied individuals presented higher scores on the Communication of Basic Needs domain. These activities tend to be more related to elements of daily communication, in which oral verbal expression is generally not required.[17] As people with aphasia tend to communicate most often with relatives or caregivers, who may become the individual's main speakers, difficulties can arise when faced with the need to communicate with strangers or in communicative interactions involving more complex or abstract subjects.[19]

An individual's level of schooling is known to affect both recovery and language performance poststroke.[37,38] Individuals with low levels of schooling employ simpler grammar structures and use more oral than written language, and they do not engage as much in social reading and writing activities.[38,39] The results obtained herein may be associated with the level of schooling of the sample; indeed, in Brazil, much of the population suffers from limited access to formal education.

STUDY LIMITATIONS AND FUTURE RESEARCH

The present results are strengthened by the fact that the functional communication assessments were performed during home visits, that is, in the very environment in which the individuals interact, which enabled us to more robustly

investigate their functional communicative performance. However, we recognize as limitations the impossibility of including, in the baseline data collected during the hospital stay, information regarding cognitive functioning and the initial severity of the aphasia. The absence of such data may have impacted the investigation of predictors of functional communication performance. For future research, the inclusion of such aspects can help to expand knowledge about the influence of cognitive functioning on functional capacity and functional communication of individuals with aphasia after stroke. In conclusion, the functional capacity assessed by the mBI at discharge from the SU was identified as a potential predictor of the performance of functional communication, regardless of the time elapsed since the stroke.

IMPLICATIONS FOR REHABILITATION

1. The ability to perform daily activities as assessed by the mBI, identified as a predictor of functional communication, can aid in planning multidisciplinary rehabilitative approaches aimed at promoting independence and functional communication in people with aphasia after stroke.
2. The characterization of skills developed as strategies for functional communication in the homes of poststroke aphasic patients expands on the body of investigation on language impairment, and can complement the existing clinical measures and other assessments of language skills and deficits.

Authors' Contributions

EBP: concept, design, definition of the intellectual content, literature search, clinical studies, data acquisition, data analysis, and manuscript preparation, editing, and review; HFM: concept, design, definition of intellectual content, clinical studies, and manuscript preparation, editing, and review; AF: concept, design, definition of the intellectual content, clinical studies, data acquisition, data analysis, and manuscript preparation, editing, and review; IM: concept, design, definition of the intellectual content, clinical studies, data analysis, and manuscript review. IGM: concept, data acquisition, literature search, and manuscript review; JOF: clinical studies, data acquisition, data analysis, and manuscript editing and review; PAJ: clinical studies, data acquisition, and manuscript review; AS, MM, and LG: data acquisition, literature search, and manuscript review.

Conflict of Interest

The authors have no conflict of interests to declare.

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