Language in Behavioral Variant Frontotemporal Dementia: Another Stone to Be Turned in Latin America

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Beyond canonical deficits in social cognition and interpersonal conduct, behavioral variant frontotemporal dementia (bvFTD) involves language difficulties in a substantial proportion of cases. However, since most evidence comes from high-income countries, the scope and relevance of language deficits in Latin American bvFTD samples remain poorly understood. As a first step toward reversing this scenario, we review studies reporting language measures in Latin American bvFTD cohorts relative to other groups. We identified 24 papers meeting systematic criteria, mainly targeting phonemic and semantic fluency, naming, semantic processing, and comprehension skills. The evidence shows widespread impairments in these domains, often related to overall cognitive disturbances. Some of these deficits may be as severe as in other diseases where they are more widely acknowledged, such as Alzheimer’s disease. Considering the prevalence and informativeness of language deficits in bvFTD patients from other world regions, the need arises for more systematic research in Latin America, ideally spanning multiple domains, in diverse languages and dialects, with validated batteries. We outline key challenges and pathways of progress in this direction, laying the ground for a new regional research agenda on the disorder.

Keywords: behavioral variant frontotemporal dementia, language, Latin America, cognitive markers, dimensional approach

INTRODUCTION

Behavioral variant frontotemporal dementia (bvFTD) is the most frequent form of frontotemporal dementia, a disease that affects between 1.2 and 1.8% of Latin American residents above age 55 (1). Patients exhibit insidious changes in personality and behavior, typically manifested as disinhibition, compulsion, apathy, hyperorality, and loss of empathy, alongside executive deficits and spared memory and visuospatial skills (2, 3). These domains have been the focus of neurocognitive studies on the disease, producing rich theoretical and clinical insights (4, 5). However, research on these predominant alterations has progressed to the detriment of less salient but still pervasive and debilitating impairments. Such is the case of language deficits.
Except for stereotypy of speech, difficulties with language production and comprehension are unmentioned in current international consensus criteria for bvFTD (3). These are also downplayed in overviews of the disease, which briefly present language as a widely preserved domain (6–8). Yet, several linguistic skills may be disrupted in bvFTD (9). For example, in a large group (10), naming deficits are as frequent as hyperorality (a core diagnostic feature) in the sample informing Rascovsky et al.’s criteria (55%). Moreover, specific language deficits often co-occur with typical bvFTD symptoms (11) and they can be observed even in pre-clinical stages (12). Also, despite lower severity, they may also resemble linguistic deficits in primary progressive aphasia (PPA) in their manifestation (13, 14) and progression rate (15). In addition, canonical atrophy patterns in bvFTD (2, 16) overlap with language-preferential regions, including the frontal, insular, cingulate, and temporal cortices (17–20). Thus, the neglect of language characterization in bvFTD research seems unwarranted.

The latter point may be particularly true in Latin America, where a major increase in the prevalence of bvFTD and other dementias (1, 21, 22) calls for precise clinical phenotyping beyond classical symptoms. Language testing is notoriously scant in regional bvFTD studies. Out of 320 reports that meet inclusion criteria in a systematic review of the topic (23), only 7.5% involve Latin American samples (Figure 1). This hinders valuable opportunities to face mounting regional challenges in the fight against dementia. Indeed, while some gold-standard diagnostic and monitoring methods (e.g., biomarkers) are either limited or broadly unavailable in most local centers (22), linguistic assessments are widely accessible and capture early deficits in bvFTD cohorts across the globe (9) as well as in Latin American individuals with other non-language-dominant disorders, such as Parkinson’s and Huntington’s disease (24–29).

Moreover, findings from other languages may not generalize to those spoken in Latin America. English, for example, is typified by abundant consonant clusters, genderless nouns, few verb forms, and greater reliance on syntax than prosody for sentential distinctions (30). Conversely, Spanish and Portuguese, the two dominant languages in the region (31), present less frequent consonant clusters, gendered nominal systems, dozens of verb forms, and greater reliance on prosody than syntax to distinguish among sentence types (32). Given that different languages may recruit distinct neural mechanisms (33) and become differently affected by similar brain disruptions (34, 35), novel, language-specific efforts are needed to understand the linguistic profile of Latin American bvFTD (LA bvFTD) patients.

As an initial step, here we contextualize and review language assessments in LA bvFTD cohorts. First, we describe general linguistic features of bvFTD as revealed in research from other world regions. Second, we summarize research conducted in Latin America. Available findings came from fluency, naming, semantic processing, and comprehension tasks. Third, we provide a critical discussion of the evidence and distill its emerging empirical patterns. Finally, we outline key challenges and future directions for the field. This way, we aim to lay the groundwork for a linguistic agenda in LA bvFTD research.

THE GENERAL LINGUISTIC PROFILE OF bvFTD

Evidence from other world regions reveals general patterns of affected and spared linguistic functions across bvFTD cohorts, with marked variability for some domains (23). Available results come mainly from studies from North America, Western Europe and Australia, with a marked predominance of English over other languages.

Motor speech is mostly spared (36). Even when they present a strangled-strained voice and articulation difficulties, patients do not exhibit more distortions, false starts, or irregular articulation breakdowns than healthy controls (37). In (semi-) spontaneous tasks, patients may produce shorter segments and abnormal pauses than controls (37). Similar patterns have been documented during text reading (37). However, their production rate is typically normal (38), and so is their rate of phonetic, phonemic, and global speech errors (39).

Performance is also mostly spared in tasks that may be performed through sub-lexical mechanisms. Patients seem unimpaired in phonological manipulation as well as word and sentence repetition (13). Repetition deficits have been observed in only 5% of cases within a large bvFTD cohort (10). On the whole, segmental phonology is widely unaffected in most patients (10, 37). However, patients often exhibit single-word reading (40) and writing (13) deficits.

Conversely, lexical and semantic functions are more systematically impaired in bvFTD. Verbal fluency, across phonemic and semantic conditions, is typically compromised (41, 42). These alterations have been linked to executive deficits (42). As for word retrieval, most studies show picture naming difficulties (43), which may prove more marked for (action) verbs than (object) nouns (13). However, patients seem only sporadically affected when naming faces (44) and smells (45), and they seem unimpaired in sound naming (46). Still, the compromise of semantic abilities appears to be widespread in bvFTD, as deficits have been reported in studies tapping conceptual knowledge (47), word comprehension and definition (48), concept association (38), semantic categorization (49), analogy processing (50), and idiom comprehension (51). Semantic disruptions are also ubiquitous in connected speech. Even though diverse lexical categories are produced with normal frequency (13), patients exhibit more word-finding problems and semantic paraphasias (52). More globally, they have difficulties in accurately reporting events, guiding communication, maintaining global coherence, and organizing discourse (53).

Syntactic processing appears to be preserved in receptive tasks using simple sentences (13). However, impairments are typically observed when using more complex stimuli, such as ambiguous sentences, constructions with synthetic or thematic violations, or discourse-level tasks (51). These difficulties may be secondary to executive deficits (54). Conversely, patients exhibit correct grammar and syntax in (semi)spontaneous production tasks (39).

Briefly, evidence from regions other than Latin America reveals general linguistic patterns in bvFTD patients. Some language domains, such as motor speech and phonology, are partly preserved. Results are more mixed for syntactic skills,
with difficulties appearing only during complex tasks. Finally, lexico-semantic abilities, including verbal fluency, appear to be widely impaired. These patterns represent a benchmark for interpreting results from Latin American cohorts, as reviewed next.

**LINGUISTIC RESEARCH IN LA bvFTD**

Following systematic criteria (see Supplementary Materials 1, 2) used in a larger systematic review of language impairments in bvFTD patients (23), we identified 24 papers reporting language assessments in LA bvFTD patients. Beyond one study assessing global language abilities, findings pertain to four main domains: phonemic fluency, semantic fluency, picture naming, and semantic processing (including comprehension). Key findings are described below and detailed in the Table 1. Also, see Supplementary Material 3 for a risk of bias assessment, revealing that only four out of the 24 papers presented high risk of bias.

**Global Language Skills**

One study (55) assessed global language abilities in LA bvFTD patients via the ACE-R language subscale, which includes measures of naming, comprehension, repetition, reading, and writing. Results revealed a significant impairment for patients relative to controls. Of note, deficits in the bvFTD cohorts were not milder than those observed in Alzheimer's disease (AD) patients.

**Phonemic Fluency**

LA bvFTD patients have impaired phonemic fluency relative to healthy controls (56–58, 60, 68–70, 72, 74, 75). This has been observed for both Spanish-speaking (57, 60, 74, 75) and Portuguese-speaking (68, 72) cohorts, across different age groups (mean age varying from 64.4 to 70.2 years old) and education levels (years of education ranging from 10.8 to 16.0 years). Non-significant differences were reported by Torralva et al. (62), although these results came from a smaller sample with higher MMSE scores than those reported in other studies. Also, phonemic fluency outcomes do not differ significantly between...
| Author, year | Participants | Language domain | Task | Main results |
|--------------|--------------|----------------|------|--------------|
| Lima-Silva et al. (55) | 20 bvFTD (mean age: 67.1) 30 AD 34 healthy participants | Global | ACE-R language | bvFTD were impaired when compared to controls but had higher scores than AD patients |
| Baez et al. (56) | 37 bvFTD (mean age: 66) 30 healthy participants | Verbal fluency | Phonological fluency (DKEFS) | A decreased phonological fluency was found in patients |
| Baez et al. (57) | 16 bvFTD (mean age: 65.8) 16 bipolar disorder 22 healthy participants | Verbal fluency | Phonological fluency (*P*) | A decreased phonological fluency was found in patients when compared to control participants but there was no difference when compared to bipolar patients; lower scores on the phonological fluency test were positively associated with lower GM volumes in the bilateral insula and putamen, the right amygdala, fusiform and inferior frontal gyri, and the left superior temporal gyrus and orbitofrontal cortex |
| Gleichgerrcht et al. (58) | 25 bvFTD (mean age: 70.0) 25 AD 26 healthy participants | Verbal fluency | Phonemic fluency | Phonemic fluency score was lower in bvFTD than in controls but did not differ from AD patients; Phonemic fluency score was correlated to both IFS and FAB scores |
| Roca et al. (59) | 18 high-functioning bvFTD (mean age: 69.1) 19 low-functioning bvFTD (mean age: 65.0) 14 healthy participants | Verbal fluency | Phonemic fluency (FAS) | Phonemic fluency score was lower in low-functioning bvFTD when compared to controls and high-functioning bvFTD; these two groups did not differ from each other; these differences were no longer significant when a global mnesic and executive score was introduced as covariate |
| Russo et al. (60) | 18 bvFTD with apathy (mean age: 58.0) 16 bvFTD with disinhibition (mean age: 57.0) | Verbal fluency | Phonemic fluency | Phonemic fluency scores did not differ between the two bvFTD subgroups |
| Santamaria-García et al. (61) | 12 bvFTD (mean age: 55.9) 12 AD | Verbal fluency | Semantic fluency (animals) | Semantic fluency scores did not differ between bvFTD and AD patients |
| Torralva et al. (62) | 20 bvFTD (mean age: 67.2) 10 healthy participants | Verbal fluency | Phonemic fluency (*P*) | Phonemic fluency scores did not differ between the two groups |
| Torralva et al. (63) | 26 mild bvFTD (mean age: 65.8) 14 moderate bvFTD (mean age: 69.9) 18 healthy participants | Verbal fluency | Phonemic fluency (*P*) | Phonemic fluency scores were lower in moderate bvFTD when compared to mild bvFTD and controls and lower in mild bvFTD when compared to controls; Phonemic fluency scores correlated positively with the Faux-Pas scores but not with the Reading Mind in the Eyes scores |
| Bahia and Viana (64) | 12 bvFTD (mean age: 63.2) 12 AD | Verbal fluency | Semantic fluency (animals) | Semantic fluency scores did not differ between bvFTD and AD patients |
| Boson-Gambogi et al. (65) | 29 bvFTD without psychiatric history (mean age: 67.9) 17 bvFTD with psychiatric history (mean age: 65.3) | Verbal fluency | Semantic fluency (animals) | No difference were found between the two groups |
| Torralva et al. (66) | 66 non-vascular bvFTD (mean age: 69.6) 23 vascular bvFTD (mean age: 78.3) | Verbal fluency | Semantic fluency (animals, vegetables) | Non-vascular bvFTD had lower scores for semantic fluency with animals but the scores did not differ for vegetables between the two groups |
| Wajman et al. (67) | 16 bvFTD (mean age: 61.9) 39 AD 22 LBD 48 Amnesic multi-domain MCI 33 Amnesic single-domain MCI 78 healthy participants | Verbal fluency | Semantic fluency (animals) | Semantic fluency scores, number of switches and number and size of clusters did not differ in bvFTD when compared to AD, Amnesic multi-domain MCI and DLB; bvFTD produced less words and less clusters than Amnesic single-domain MCI but did not differ on other measures (cluster size, number of switches); bvFTD produced less words, less and shorter clusters and less switches than controls |

(Continued)
TABLE 1 | Continued

| Author, year | Participants | Language domain | Task | Main results |
|--------------|--------------|----------------|------|--------------|
| Bahia et al. (68) | 18 bvFTD (mean age: 70.2) 20 AD 15 healthy participants | Verbal fluency | Phonemic fluency (“P”), semantic fluency (animals) | Both fluency scores were lower in bvFTD than in controls and did not differ between the two patients groups |
| Couto et al. (69) | 22 bvFTD (mean age: 69.8) 10 non-fluent PPA 18 healthy participants | Verbal fluency | Phonemic fluency (“P”), semantic fluency (animals) | Both fluency scores were lower in bvFTD than in controls and did not differ between the two patients groups |
| Gleichgerrcht et al. (58) | 13 bvFTD without dilemma judgment impairment (mean age: 71.4) 9 bvFTD with judgment impairment (mean age: 71.2) | Verbal fluency | Phonemic fluency (“P”), semantic fluency (animals) | Both fluency scores were lower in bvFTD with dilemma judgment impairment than in bvFTD without |
| Gleichgerrcht et al. (70) | 35 bvFTD (mean age: 68.5) 10 PPA 14 healthy participants | Verbal fluency | Phonemic fluency (“P”), semantic fluency (animals) | Both phonemic and semantic fluency scores were lower in bvFTD than in controls; Semantic fluency was lower in PPA than in bvFTD and phonemic fluency did not differ between the two groups |
| Manes et al. (71) | 30 bvFTD with impaired neuropsychological performance (mean age: 69.3) 13 with normal neuropsychological performance (mean age: 67.5) 14 healthy participants | Verbal fluency | Phonemic fluency (“P”), semantic fluency (animals) | Both fluency scores were lower in the neuropsychologically impaired bvFTD than in controls but did not differ between non-impaired bvFTD and controls; While phonemic fluency scores were lower in the impaired bvFTD group than in the non-impaired bvFTD group, semantic fluency scores did not differ between the two groups; in the impaired bvFTD subgroup, phonemic and semantic fluency scores correlated with a decision-making task |
| Mariano et al. (72) | 27 bvFTD (mean age: 68.0) 24 AD 25 healthy participants | Verbal fluency | Phonemic fluency (FAS), semantic fluency (animals) | Both fluency scores were lower in bvFTD than in controls and did not differ between the two patients groups |
| Ramanan et al. (73) | 44 bvFTD (mean age: 65.3) 48 AD | Verbal fluency | Phonemic fluency (“A”), semantic fluency | Both fluency scores did not differ between bvFTD and AD patients; phonemic fluency score did not correlate with ToM task score |
| Reyes et al. (74) | 50 bvFTD (mean age: 65.9) 12 nfvPPA 14 svPPA patients 32 healthy participants | Verbal fluency | Phonemic fluency (“P” and “M”), semantic fluency (animals) | Both fluency scores were lower in bvFTD than in controls and higher in bvFTD compared to both nfvPPA and svPPA patients groups |
| Reyes et al. (75) | 26 bvFTD (mean age: 64.4) 20 nfvPPA 20 svPPA patients 33 healthy participants | Verbal fluency | Phonemic fluency, semantic fluency | Both fluency scores were lower in bvFTD than in controls and higher in bvFTD compared to both nfvPPA and svPPA patients groups |
| Torralva et al. (76) | 16 high-ACE bvFTD (mean age: 69.1) 19 low-ACE bvFTD (mean age: 65.0) 10 healthy participants | Verbal fluency | Phonemic fluency (“P”), semantic fluency (animals) | Phonemic fluency was lower in low-ACE bvFTD when compared to controls and high-ACE bvFTD; these two groups did not differ from each other; Phonemic fluency scores did not correlate with a global social cognitive score but did positively correlate with the Reading Mind in the Eyes scores |
| Couto et al. (69) | 22 bvFTD (mean age: 69.8) 10 nfvPPA 18 healthy participants | Naming | Boston Naming Test | Picture naming was impaired in bvFTD patients as well as in the non-fluent PPA patients. bvFTD performance was better than non-fluent PPA. |
| Gleichgerrcht et al. (58) | 13 bvFTD without dilemma judgment impairment (mean age: 71.4) 9 bvFTD with judgment impairment (mean age: 71.2) | Naming | Boston Naming Test | No difference were found between the two groups. |
| Author, year       | Participants                                      | Language domain | Task                                      | Main results                                                                                                                                                                                                 |
|-------------------|---------------------------------------------------|-----------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gleichgerrcht et al. (70) | 35 bvFTD (mean age: 68.5)  
10 PPA  
14 healthy participants | Naming          | Boston Naming Test                        | Picture naming was preserved in bvFTD patients. bvFTD patients presented higher scores than PPA patients.                                                                                                                                                        |
| Manes et al. (71)  | 30 bvFTD with impaired neuropsychological performance (mean age: 69.3)  
13 with normal neuropsychological performance (mean age: 67.5)  
14 healthy participants | Naming          | Boston Naming Test                        | Picture naming scores were lower in the neuropsychologically impaired bvFTD than in controls but did not differ between neuropsychologically non-impaired bvFTD and controls. The neuropsychologically impaired bvFTD group scores were lower than the non-impaired bvFTD group. |
| Reyes et al. (75)  | 26 bvFTD (mean age: 64.4)  
20 nfvPPA  
20 svPPA patients  
33 healthy participants | Naming          | Confrontation naming test from Montanes et al. (77) | Picture naming was preserved in vbFTD patients compared to controls. bvFTD patients presented higher scores for both nfvPPA and svPPA.                                                                                                                                         |
| Roca et al. (59)   | 16 high-functioning bvFTD (mean age: 69.1)  
19 low-functioning bvFTD (mean age: 65.0)  
14 healthy participants | Naming          | Boston Naming Test                        | Low-functioning bvFTD differed from both high-functioning bvFTD and healthy controls groups. High-functioning bvFTD patients did not differ from healthy controls.                                                                                           |
| Russo et al. (60)  | 27 bvFTD (mean age: 66.5)  
46 AD  
17 PPA  
40 healthy participants | Naming          | Boston Naming Test                        | All patients’ groups differed from healthy controls. The bvFTD’s group did not differ with the remaining patient’s groups.                                                                                                                                             |
| Santamaria-Garcia et al. (78) | 20 bvFTD (mean age: 58.9)  
24 AD  
20 healthy participants | Naming          | Picture-naming task from Snodgrass and Feenan (79) | No significant differences between groups (groups matched by picture naming scores).                                                                                                                                                                               |
| Torralva et al. (62) | 20 bvFTD with early/mild stage (mean age: 67.2)  
10 healthy participants | Naming          | Boston Naming Test                        | Picture naming was impaired in bvFTD patients.                                                                                                                                                                                                                   |
| Torralva et al. (76) | 16 high-ACE bvFTD (mean age: 69.1)  
19 low-ACE bvFTD (mean age: 65.0)  
10 healthy participants | Naming          | Boston Naming Test                        | Low-ACE bvFTD differed from both high-ACE bvFTD and healthy controls groups. High-ACE bvFTD patients also differed from healthy controls.                                                                                                                           |
| Torralva et al. (63) | 66 bvFTD without vascular event history (mean age: 69.6)  
23 bvFTD with vascular event history (mean age: 78.3) | Naming          | Boston Naming Test                        | No significant differences between groups.                                                                                                                                                                                                                       |
| Gleichgerrcht et al. (70) | 35 bvFTD (mean age: 68.5)  
10 PPA patients  
14 healthy participants | Semantic association | Pyramids and Palm trees | Semantic association was impaired in bvFTD patients compared to controls. BvFTD patients did not differ from PPA patients.                                                                                                                                         |
| Roca et al. (59)   | 16 high-functioning bvFTD (mean age: 69.1)  
19 low-functioning bvFTD (mean age: 65.0)  
14 healthy participants | Semantic association | Pyramids and Palm trees | Low-functioning bvFTD differed from healthy controls. The high-functioning bvFTD group did not differ from both low-functioning and healthy controls groups.                                                                                         |
| Torralva et al. (62) | 20 bvFTD with early/mild stage (mean age: 67.2)  
10 healthy controls | Semantic association | Pyramids and Palm trees | Semantic association was impaired in bvFTD patients.                                                                                                                                                                                                                   |
TABLE 1 | Continued

| Author, year | Participants | Language domain | Task | Main results |
|--------------|--------------|-----------------|------|--------------|
| Gleichgerrcht et al. (58) | 13 bvFTD without dilemma judgment impairment (mean age: 71.4) 9 bvFTD with judgment impairment (mean age: 71.2) | Comprehension | Token Test | No difference were found between the two groups. |
| Gleichgerrcht et al. (70) | 35 bvFTD (mean age: 68.5) 10 PPA patients 14 healthy participants | Comprehension | Token Test | Comprehension was preserved among all patients groups. |
| Torralva et al. (62) | 20 bvFTD with early/mild stage (mean age: 67.2) 10 healthy controls | Comprehension | Token Test | Comprehension was preserved in bvFTD patients. |
| Torralva et al. (76) | 16 high-ACE bvFTD (mean age: 69.1) 19 low-ACE bvFTD (mean age: 65.0) 10 healthy participants | Comprehension | Token Test | Low-ACE bvFTD differed from both high-ACE bvFTD and healthy controls groups. High-ACE bvFTD patients did not differ from healthy controls. |
| Reyes et al. (75) | 26 bvFTD (mean age: 64.4) 20 nfvPPA (mean age: 63.6) 20 svPPA patients (mean age: 60.3) 33 healthy participants | Comprehension | Proverbs | Proverbs comprehension was impaired in the bvFTD group compared to healthy participants. Moreover, bvFTD also showed better performance than the svPPA group. |
| Reyes et al. (74) | 50 bvFTD (mean age: 65.9) 12 nfvPPA (mean age: 63.63) 14 svPPA patients (mean age: 60.3) 32 healthy participants | Comprehension | Proverbs | All patients’ groups differed from healthy controls. The bvFTD group did not differ with the remaining patient groups. |

bvFTD and AD ([58, 68, 72, 73], but see [60]). Comparisons with PPA have yielded mixed results: while some studies report better performance for bvFTD than non-fluent variant PPA and semantic variant PPA patients ([74, 75], other found no significant difference between groups ([60, 69, 70]).1 Phonetic fluency performance in LA bvFTD patients has been shown to correlate with the volume of core affected regions – e.g., the bilateral insula and putamen, the right amygdala, fusiform and inferior frontal gyri, and the left superior temporal and orbitofrontal cortices (57).

These impairments may be linked to overall cognitive functioning. LA bvFTD patients with global cognitive difficulties are outperformed by both healthy controls and cognitively preserved LA bvFTD patients ([59, 63, 71, 76], there being no difference between the latter two groups ([59, 71, 76], but see [63]). Phonetic fluency may also be associated with executive ([59, 80] and mnesic (59) skills.

The links between this domain and social cognitive functioning are less clear. Phonetic fluency does not seem to be associated with measures of theory of mind ([73, 76], empathy (56), or global socio-cognitive skills (76). Also, no difference has been reported in phonemic fluency scores between patients with utilitarian and non-utilitarian moral profiles (80). Note that, beyond social cognition domains, similar phonemic fluency outcomes have been reported between apathetic and disinhibited patients (61). However, positive correlations have been reported between phonemic fluency scores and the Reading-the-Mind-in-the-Eyes test, a Faux-Pas task (63), and a decision-making task (71).

In short, phonemic fluency appears to be compromised in LA bvFTD patients. The severity of this impairment resembles that observed in AD and may even reach the degree of impairment seen in non-fluent and semantic PPA. Reported deficits seem driven by wider executive impairment, whereas their relationship to social cognitive functioning remains poorly understood.

Semantic Fluency

Semantic fluency assessments also reveal systematic deficits in LA bvFTD samples ([58, 67–70, 72, 74, 75]). As is the case with phonemic fluency, this impairment is consistent for both Spanish ([74, 75]) and Portuguese ([67, 68, 72]), in cohorts with

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1 For comparisons of other fluency measures in connected speech, see Reyes (75).

bvFTD, behavioral variant frontotemporal dementia; AD, Alzheimer’s disease; PPA, primary progressive aphasia; svPPA, semantic variant PPA; nfvPPA, non-fluent variant PPA; lvPPA, logopenic variant PPA; ACE, Addenbrooke’s Cognitive Assessment.
different mean ages (varying from 61.9 to 70.2 years old) and education levels (year of education ranging from 8.7 to 16.0 years). In particular, emerging evidence (67) suggests that, compared with healthy controls, LA bvFTD patients produce fewer and smaller semantic clusters (words retrieved according to semantic subcategories such as pets, birds, or felines, for animals) as well as fewer switches (shifts from one semantic subcategory to another). Semantic fluency deficits in LA bvFTD patients seem less strong than those observed in non-fluent and semantic variant PPA ([70, 74, 75], but see (69)) but as severe as those of patients with amnestic mild cognitive impairment (67) and AD (64, 67, 68, 72, 73).

Such difficulties may be related to global cognitive alterations. Indeed, sub-group analyses reveal that deficits are present in cognitively compromised, but not in cognitive spared, LA bvFTD patients (71, 76). In a similar vein, Wajman et al. (67) found significant positive correlations between semantic fluency measures and MMSE scores.

Additional evidence suggests a link with social cognition skills. Although semantic fluency scores may not differ between patients with utilitarian and non-utilitarian moral profiles (80), they are correlated with decision-making scores (71). Semantic fluency in LA bvFTD cohorts may also be influenced by cerebrovascular disease, as patients without such comorbidity had lower scores on specific categories (animals) (66). Finally, there seems to be no difference in semantic fluency between bvFTD patients with and with psychiatric history (65).

In sum, semantic fluency is systematically impaired in LA bvFTD patients. Deficits are less marked than in PPA variants, but they prove comparable to those of persons with mild cognitive impairment or AD. Such difficulties seem related to more global cognitive and socio-cognitive deficits.

**Picture Naming**

Picture naming appears to be mostly impaired in LA bvFTD samples. Available evidence comes from Spanish speakers aged between 65 and 70, with a range of roughly 12–15 years of education. Most studies employed the Boston Naming Test, revealing significant differences between patients and controls (60, 70, 71, 74–76); but see (70). Interestingly, no significant deficits were revealed via an experimental naming test designed for AD (75). Moreover, separate studies reported that naming performance in LA bvFTD patients was better than in non-fluent variant and semantic variant PPA (75) and heterogeneous PPA cohorts (70).

Naming deficits might be related to the patients’ global cognitive impairment levels, as they prove significantly greater in low- vs. high-functioning LA bvFTD cohorts (59, 71, 76). Indeed, normal naming performance has been reported in the latter subgroup (59). Conversely, picture naming did not differ between patients with utilitarian and non-utilitarian moral profiles (80) or prior history of stroke or silent brain infarcts (66).

Briefly, picture naming seems compromised in LA bvFTD patients, though not as markedly as in PPA variants. These deficits might be driven by the patients’ cognitive status, but they seem uninfluenced by socio-cognitive abilities or neurovascular events.

**Semantic Processing and Comprehension**

Concept association, as tapped with the Pyramids and Palm Trees test, seems to be impaired in LA bvFTD cohorts (59, 62, 70). However, this pattern seems driven by cognitively impaired patients. In fact, these are outperformed by high-functioning ones, who actually reach normal scores (62). Patients also exhibit deficits in proverb comprehension (74, 75), suggesting impaired figurative language skills. Still, these difficulties are significantly less marked than those of semantic variant PPA and non-fluent variant PPA patients (75).

Conversely, comprehension of increasingly complex commands, as captured by the Token Test, seems globally preserved in LA bvFTD individuals (62, 70). However, this domain also seems sensitive to cognitive decline, as poorer performance has been observed in low- relative to high-functioning patients (76). Furthermore, this domain does not seem to differ between patients with utilitarian and non-utilitarian moral profiles (80).

In sum, LA bvFTD patients seem to exhibit concept association and figurative language comprehension deficits, with preserved abilities to grasp verbal commands. At least some of these patterns might be driven by overall cognitive skills.

**DISCUSSION**

Though moderate in quantity and scope, existing findings allow the identification of potential empirical patterns. First, LA bvFTD cohorts exhibit systematic deficits in phonemic and semantic fluency. This impairment is consistent across education levels, age ranges, and in the two languages most widely spoken by Latin Americans: Spanish and Portuguese (31). Interestingly, fluency is also the most consistently disrupted domain across bvFTD patients from other regions, yielding deficits in 76% of cases (10). The detection of naming deficits also aligns with reports showing their presence in more than half of patients (10), matching the incidence of hyperorality, a core diagnostic symptom (3). Difficulties have also been observed in tasks requiring semantic processing and comprehension of complex commands, probably driven by global cognitive deficits.

Despite the widespread dismissal of language deficits in bvFTD, such patterns are not fully surprising. Indeed, the above domains have all been linked to brain regions canonically disrupted in bvFTD. This is true of phonemic fluency, subserved by inferior frontal, insular, and medial temporal regions (81); semantic fluency, linked to frontal, posterior temporal, and inferior parietal regions (81); naming, associated with middle temporal, angular, dorsolateral prefrontal, and inferior frontal regions (82, 83); and semantic processing, underpinned by temporal, inferior/medial prefrontal, occipital, and subcortical regions (84).Compatibly, limited evidence in our review shows that phonemic fluency deficits in Spanish-speaking bvFTD patients are associated with atrophy in inferior frontal, orbitofrontal, and anterior, superior and mesial temporal regions (57). Such links reinforce the relevance of language deficits in the disease.
Comparisons with other diseases illuminate the severity of these impairments in LA bvFTD patients. Deficits in semantic fluency (60, 69, 70), naming (70, 75), semantic association, and comprehension (75) are milder than in PPA variants, which are mainly typified by language impairments (85). One study reported comparable semantic fluency difficulties in LA bvFTD and non-fluent PPA patients (69), potentially driven by partly similar atrophy patterns along frontal regions. Phonemic fluency, which hinges on both linguistic and executive control mechanisms, more consistently yielded similar deficits in LA bvFTD and non-fluent PPA (60, 69, 70), which is mainly distinguished by disruption of language-sensitive fronto-insular networks (85). The latter point could suggest that impaired performance in each syndrome might be driven by different factors, such as executive dysfunction in LA bvFTD and linguistic impairment in PPA (39).

More interestingly, several domains seem as markedly impaired in bvFTD as in AD, a disease in which specific verbal dysfunctions range from frequent (in amnestic presentations) to systematic (in linguistic presentations) (86). In our review, comparable outcomes between these diseases have been reported for global language skills, as evaluated with the ACE-R language scale (55), as well as phonemic (58, 68, 72, 73) and semantic (64, 67, 68, 72, 73) fluency tasks. The same pattern has been reported among speakers of English (87) and Italian (88). However, other domains recruiting both linguistic and executive mechanisms, such as picture naming and syntax, may be differentially affected in LA bvFTD and AD (13, 89), calling for further research on cross-nosological and disease-specific markers.

More generally, evidence from Latin America aligns with global findings supporting the relevance of linguistic assessments in bvFTD, even if these are not primarily affected in the disease (9). In the same vein, previous research has emphasized the usefulness of social cognition assessments in PPA variants, although these syndromes are characterized primarily by language deficits (90). Such approaches underscore the clinical value of assessments that go beyond core symptoms, leading to more exhaustive characterizations to establish individual profiles and personalized plans to treat each patient’s more salient disruptions. At the same time, they align with transnosological and dimensional perspectives that frame cognitive outcomes in a continuum between normal and pathological extremes cutting across diseases with different core symptomatology (4). Even deficits that escape core diagnostic criteria may be informative for clinical purposes.

CHALLENGES AND FUTURE DIRECTIONS

Gaps in the Study of Language in LA bvFTD Patients

The study of language impairments in bvFTD across Latin America is already informative and promising. However, it is marked by important gaps, especially when compared to work conducted elsewhere. First, the evidence is scant and it secondarily covers only a few, coarse-grained domains, whereas research in other world regions proves more abundant, varied, and granular. In addition, few studies have examined associations between linguistic outcomes, non-verbal cognitive skills, and neural correlates, while none has employed longitudinal designs to evaluate language impairment progression. This hinders the detection of robust and clinically useful patterns, as well as the integration of local results with global findings. The scenario is further complicated by the overlap of patients across reports from the same groups, a problem that also challenges interpretability of findings in other parts of the world.

Second, despite the vast extension of the territory, available results come from only a few centers distributed in three countries (Argentina, Brazil, and Colombia). Accordingly, existing findings may fail to represent the diversity of Latin Americans across regional subgroups—a factor known to affect other aspects of dementia presentation (91). More extensive recruitment across regional clinics and hospitals would be critical to extend the cross-national scope of the evidence. Finally, available data comes only from Portuguese- and Spanish-speaking cohorts, which falls short of capturing the region’s linguistic diversity, with over 450 languages (31) and an even larger number of dialects (92). Note that different languages (34), and even different dialects of the same language (93, 94), may become differentially affected by brain disease, so that existing results may not be readily extrapolated across the territory.

Future work should strongly aim to cover these gaps, mainly by acknowledging diversity as a pressing matter and encouraging the exploration of culture-specific variables in a cross-regional agenda. This could be achieved through multicentric efforts, such as those spearheaded by the Consortium to Expand Dementia Research in Latin America—ReDLat (95), offering adequate sample sizes, socio-cultural and dialectal diversity, and ecologically valid measures. In fact, ReDLat is already poised to implement classical (e.g., picture naming) and cutting-edge (e.g., automated speech analyses) tools capturing linguistic features in over 1,000 LA bvFTD patients spanning six countries, two languages (Spanish and Portuguese), and numerous dialects. Moreover, the consortium’s multicentric structure is already being leveraged to launch language-focused projects, including novel assessments in bvFTD and AD samples through a combination of automated (acoustic and textual) measures, gold-standard multi-level tests, and validated language profile questionnaires. In the near future, the cross-dialectal scope of these efforts could be fruitfully extended beyond the region through direct contrasts between bvFTD cohorts from Latin America, Spain, and Portugal. This would also cater for a more balanced representation of sites from different countries, as language measures, so far, have been reported in only three bvFTD studies from Spain (96–98) and one from Portugal (99).

Furthermore, these limitations also apply to several other world regions where language studies in bvFTD range from incipient to fully absent. This is the case, for instance, with African countries, most Asian countries, and Russia. Therefore, from a more global perspective, our present call for further Latin American research on the topic should be seen as an instantiation of a broader, cross-national need to be met by the field.
Clinical and Research Recommendations

This review also highlights the need for Latin American researchers and clinicians to use more sensitive and specific language measures. One of the most systematically assessed domains in LA bvFTD patients is verbal fluency. Although highly useful to detect cognitive impairment in this population, fluency tests are not sufficient to investigate language functioning in bvFTD, calling for more specific tasks.

The Boston Naming Test was the most frequently used naming task in the reviewed studies. However, this test can underestimate Spanish proficiency (100). In this sense, the Multilingual Naming Test might be more culturally and linguistically appropriate to investigate naming abilities in monolingual and multilingual Spanish speakers, and it has been shown to be useful clinically in neurodegenerative populations (101).

The Pyramids and Palm Trees Test was the most frequently used semantic task in our review. As semantic memory is one of the most culturally specific cognitive domains, researchers have developed and validated a culturally and linguistically appropriate version for Spanish speakers, the Pyramids and Pharaohs Test (102). In addition to being shorter (20 vs. 52 trials), this new version also shows a higher sensitivity and specificity to semantic impairments in a Spanish-speaking population.

Finally, the Token Test, which was used frequently in primary studies in the present review, appears appropriate for Latin American patients and it has Spanish and Portuguese norms (103, 104). Nonetheless, no study has investigated motor speech, phonology or syntax in LA bvFTD patients. Prosodic and discourse-based measures, which have also shown to be extremely useful to characterize language impairments in bvFTD patients, have not been used either. Besides a few general language instruments, such as the Bilingual Aphasia Test (105), the Communicative Abilities in Daily Living battery (106), and the Boston Diagnostic Aphasia Examination (107), there is a dearth of fine-grained tools for assessing language in Latin American individuals. The development of such instruments could stimulate regional research on bvFTD and other neurodegenerative conditions.

Moreover, major strides could be made by incorporating automated speech analysis tools (108, 109), which allow capturing multiple acoustic (e.g., prosodic, articulatory) and linguistic (e.g., lexico-semantic, morphosyntactic) features from brief excerpts of natural speech. Relative to standard assessments, this approach presents numerous advantages (e.g., low cost, objective results, ecological validity, scalability), and it has already proven sensitive to bvFTD patients from other world regions (110). In line with recent works on Latin American patients with other neurodegenerative disorders (25, 26), automated speech assessments could open new vistas for translational research on regional bvFTD cohorts.

CONCLUSION

The prominence of behavioral and personality changes in bvFTD may have led to a partial dismissal of other cognitive deficits, including linguistic ones. This is unfortunate for underserved regions, such as Latin America, given that language assessments in bvFTD may be sensitive, discriminative, less costly, and more scalable than other diagnostic and monitoring methods. Our review indicates that deficits in verbal fluency, naming, and semantic domains are common and informative across LA bvFTD cohorts, but it also highlights the paucity of evidence, the lack of studies employing fine-grained and cutting-edge tools, and the poor coverage of languages and dialects across the region. Looking forward, multicentric approaches to language in LA bvFTD samples could be of great clinical value, paving the way for more thorough characterizations of patient profiles and novel avenues to support mainstream diagnostic tests.

AUTHOR CONTRIBUTIONS

AMG developed the study concept and the study design. AG and MM performed the literature review. AG, MD, MM, and AMG interpreted the data and wrote the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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