Bilingual aphasia: Grammatical category-specific deficits

Autor: Val Mejuto, Janire (Licenciada en Filología Inglesa y Máster en Psicolingüística, Profesora de Inglés en Educación Secundaria).
Público: Psicolingüística. **Materia:** Inglés. **Idioma:** Español.

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Resumen
This article is centred on exploring the mechanisms of bilingual aphasia and how they have contributed to shedding light on bilingualism and their mental representation of languages. In addition, it will also examine how the language disorder or aphasia affects the bilingual brain compared to that of a monolingual, paying particular attention to grammatical category specific deficits. In addition, it will also summarize the different theories that have been raised to account for these effects in bilinguals, and the limited research conducted with bilinguals suffering from aphasia.
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Abstract
This article is centred on exploring the mechanisms of bilingual aphasia and how they have contributed to shedding light on bilingualism and their mental representation of languages. In addition, it will also examine how the language disorder or aphasia affects the bilingual brain compared to that of a monolingual, paying particular attention to grammatical category specific deficits. In addition, it will also summarize the different theories that have been raised to account for these effects in bilinguals, and the limited research conducted with bilinguals suffering from aphasia.
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Recibido 2018-09-28; Aceptado 2018-10-03; Publicado 2018-10-25; Código PD: 100175

During the second half of the nineteenth century, experts in the fields of physiology and clinical medicine were concerned with determining how the faculty of language was represented in the brain (e. g., Lorch, 2007). In addition, the findings of the determinant roles that the Broca's area and Wernicke's area exercise in the production and comprehension of language were decisive to understand the complex structure and organization of the brain. Moreover, discerning the unique mechanisms that bilinguals use to represent two languages in the brain and avoid interference when speaking in the target language have been intriguing scholars since 1890s. Furthermore, with the publication of *Etude sur l'aphasie chez les polyglots* (1895) Albert Pitres pioneered in the field by examining multilingual patients suffering from verbal amnesia. Importantly, he addressed the question of how multiple languages are represented in the brain, as he attempted to account for the different recovery patterns reported in bilingual aphasics (e. g., Lorch, 2007). Hence, this essay will be centred on bilingual aphasia. Therefore, I will discuss the limited research done in the field by specially focusing on the noun-verb dissociation deficit that has been considerably reported in monolingual aphasics. Thus, the first part of the essay will provide a brief and general overview of how studies in bilingual aphasia have contributed to bilingualism. Secondly, I will describe the different theories raised to account for the grammatical class-specific deficit, and I will briefly describe the studies done considering monolinguals to compare them to those conducted on bilingual aphasia.

CONTRIBUTIONS OF BILINGUAL APHASIA TO THE UNDERSTANDING OF THE BILINGUAL BRAIN

Undoubtedly, the analyses of the linguistic performance of aphasic patients have provided important insights into how languages are represented in the bilingual brain (Fabbro 2001). Moreover, by observing how brain damage affects linguistic abilities and specific brain areas, important conclusions have been drawn with regard to recovery patterns or language organization in the brain (Ijalba, Obler & Chengappa, 2006).

During the last decades the idea that the right hemisphere may contribute to the representation of the second language of a bilingual has centered the debates in neurolinguistics (Wong, 2006). In addition, recent neuropsychological studies have claimed that age and form of acquisition may influence how languages of a bilingual are represented in the

brain. Paradis (1994) argued that due to the different learning systems that underlie the acquisition of the first language (L1) and second language (L2) different cerebral systems are involved in the representation of the languages of a bilingual. Thus, while L2 is learned formally, engaging the cerebral cortex and using declarative memory, L1 is acquired informally by exposure to conversational input, involving subcortical structures (mainly the basal ganglia and cerebellum) and using procedural memory. Hence, the right hemisphere seems to be engaged in the initial stages of L2 learning in order to compensate with pragmatic inferences their still limited competence in L2 (Fabbro, 2001).

In addition, evidence supporting the dissociation between implicit and declarative memories and their role in the representations of L1 and L2 has been reported by Aglioti and Fabbro (1993) who analysed the linguistic performance of EM, an aphasic patient with an ischaemic lesion involving the left basal ganglia. They reported that EM could not speak Veronese (her L1) and could only communicate in Italian (her L2). Similarly, García-Caballero et al. (2007) analysed the linguistic performance of a bilingual patient suffering crossed aphasia that started using her less practiced L2 language (Spanish) instead of her L1 (Galician). It is worth mentioning that she never learnt to read or write in their L1 and she was only exposed to her L1 until the age of 8. They concluded that the basal ganglia perform an important role in the representation of L1.

Moreover, other aspects such as degree of education and most importantly proficiency level have been proved to be determinant in the organization of languages of the bilingual in the brain. In fact, Hernández, Martínez and Kohnert (2000) found that while both languages of the balanced bilingual share common areas in the brain, the languages of unbalance bilinguals are represented in different areas. Accordingly, Fabbro (2001) suggested that both languages of the bilingual are coded in the brain according to the proficiency level and that the age of acquisition does not constitute a determinant factor.

GRAMMATICAL CATEGORY SPECIFIC DEFICITS REPORTED IN MONOLINGUAL AND BILINGUAL APHASIA

Bilingual aphasic patients have shown that their languages are differently impaired (e. g., Paradis, 1977). Therefore, Paradis (2001) underlined the importance of analysing the specific errors that the bilingual aphasic produces in their languages as they may be important symptoms for diagnosing the type of aphasia that the patient suffers and to apply an effective treatment. For example, Laka and Korostola (2001) reported that a bilingual aphasic showed impairment in the verbal inflection in Basque which interestingly coincides with one of the distinctive features of the language.

Moreover, in recent years, grammatical category specific dissociations have been discovered in brain damaged patients. This deficit alludes to the inability of the aphasic patient to name verbs compared to nouns or vice versa. Moreover, these grammatical class effects have been reported in patients suffering different types of primary progressive aphasia (PPA) which is defined “as a clinical syndrome due to degenerative disease that results in progressive language disturbance for at least 2 years before deterioration in other cognitive domains occurs” (Hillis et al. 2006, p. 247). The linguistic production of patients affected by semantic dementia (SD), a type of fluent PPA, has revealed a notorious deficit in naming nouns compared to verbs. Conversely, the linguistic performance of individuals suffering from primary progressive non-fluent aphasia (PNFA) seems to be characterized by a remarkable impairment in naming verbs compared to nouns.

It has been argued that the locus of this category-specific deficit may be explained as impairment at the semantic level due to the different processing demands of both grammatical classes. Therefore, since nouns tend to designate more concrete and more imageable objects and verbs involve more abstract and less imageable actions, damage to either of these semantic representations would account for specific grammatical category deficits (e. g., Damasio & Tranel, 1993).

Furthermore, Daniele, Silveri, Giustolisi and Gainotti (1993) argued that different structures of the brain may be involved in the processing of grammatical categories. While systems located in the temporal lobe may be engaged in the processing and production of nouns, regions in the frontal lobe may be responsible for the processing of verbs. Evidence supporting this hypothesis was found by Caterina Silveri, Perri and Cappa (2003) who analyzed the linguistic performance of CG, a patient affected by semantic dementia, and SA who presented a left parietal lesion. While the former showed an initial impairment in the production non-living nouns which later extended to living or proper nouns, the latter was unable to produce verbs and present difficulties in sentence construction (e. g., Berndt, Haendiges, Mitchum & Sandson, 1997). The authors interpreted these results as supporting evidence for different brain regions involved in the processing of nouns compared to verbs (e. g, Hillis, Tuffiash & Caramazza, 2002, Shapiro, Pascual-Leone, Mottaghy, Gangitano & Caramazza, 2001). In other words, while temporal structures seems to be involved in the processing of nouns, the

frontoparietal structures are responsible for the processing of verbs (e. g., Bak, O'Donovan, Xuereb, Boniface & Hodges, 2001).

In addition to the same grammatical category dissociation, Caramazza and Hillis (1991) found a modality specific deficit. They analysed the linguistic performance of HW who suffered aphasia due to stroke with damage in the parietal region of the left hemisphere, and SJD affected by aphasia due to stroke and presented damage to the left frontotemporal region. They found that HW could pronounce nouns better compared to verbs, while she did not show such noun-verb dissociation in written output. SJD wrote nouns better compared to verbs while she produced equally nouns and verbs. The authors affirmed that the noun-verb dissociation seems to be due to grammatical class effects and not to difficulty in processing abstract words compared to concrete words. Therefore, they presented participants with homonyms (e. g. *present* which can be a noun meaning *gift* or a verb *show*) and they found that these modality and grammatical category deficits persisted. Since both patients showed normal comprehension with inability to produce nouns or verbs in one modality output, it can be noted that both HW and SJD had impaired access to orthographic or phonological representations of the words. The authors interpreted these results as evidence suggesting that the principle of grammatical class could not only affect the organization of the lexicon but it may extend as an organizing principle of the phonological and orthographic representations as well.

Similar modality specific effects were found by Hillis et al. (2006) analysed the performance of 56 participants affected by PNFA, SD and frontotemporal dementia (ALS-FTD). They found that while patients with PNFA as well as ALS-FTD presented impairment in uttering verbs in both spoken and written output while patients with SD showed difficulty in producing and comprehending nouns. Since the patients affected by PNFA and ALS-FTD performed well in the picture and word association tests a semantic locus of their deficit is discarded. The authors interpreted these results as evidence suggesting that patients affected by PNFA do not have access to the phonological representation rather than impaired access to semantic representations of verbs. The locus of the noun impairment of patients affected by SD may be at the semantic level and may affect as well orthographical representations of both verbs and nouns consequently affect spelling and reading comprehension.

Moreover, these grammatical class and modality specific deficits have been recently reported in bilingual aphasics. Hernández, Costa, Sebastián-Gallés, Juncadella and Gascón-Bayarri (2007) analysed the linguistic performance of LPM a highly proficient bilingual affected by Alzheimer's disease. They found that the patient found difficulty in naming nouns compared to verbs, thus showing a grammatical category specific deficit. The fact that she was able to describe the pictures that she was unable to name suggests that the semantic representations of the target words were intact and thus, the locus of the deficit is not located at a conceptual level. Hence, the authors interpreted these results as supporting evidence for a grammatical category impairment affecting representations at the lexical level. This noun-verb dissociation deficit affected both languages and thus, they claimed that L1 and L2 of highly proficient bilinguals are representing in overlapping areas in the brain and organized following similar principles of grammatical class.

Similarly, Hernández et al. (2008) analysed the linguistic performance of JPG, a highly proficient Spanish-Catalan bilingual affected by PPA. He showed a grammatical category specific deficit with a selective impairment in naming verbs compared to nouns in written and oral production in both languages. Since no significant differences were reported in comprehending verbs compared to nouns and JPG could access the correct initial phoneme and thus the semantic representation of the target word he was unable to name, the authors suggested that this dissociation could not be explained as a mere semantic deficit.

Therefore, Hernández et al. (2008) stated that the locus of this selective impairment could not remain at the conceptual level but at a lexical level in order to accommodate these results. In addition, as similar noun-verb dissociation was reported for both languages, they claimed that the two lexicons of a bilingual may be organized in relation to grammatical class. The authors propose that different parts of the brain are responsible for processing verbs and nouns and they may be affected differently after brain-damage. Conversely, lexicons may be segregated and words may be associated with grammatical features and damage to these grammatical features may affect how words are retrieved. In addition, they interpreted the better performance of L1 compared to L2 as evidence supporting that first acquired language, age of acquisition and form of instruction may affect the nature of this two languages.

Furthermore, Kambanaros and Steenbrugge (2006) compared the performance of 12 Greek-English patients with fluent anomic aphasia with 12 healthy bilinguals. They found that comprehension of both nouns and verbs was preserved. Nevertheless, a grammatical category specific deficit was reported in naming in which bilinguals showed a verb impairment compared to noun which was more pronounced in their L2 rather than L1. Therefore, it can be concluded that

this noun-verb dissociation is not language specific. They reported a similar difficulty in retrieving English verbs compared to their Greek counterparts for both aphasic and non-brain damaged participants. Moreover, aphasic patients found more difficulty in retrieving L2 instrumental verbs with a noun-name relation than L2 instrumental verbs without a noun-name relation. They interpreted these results as evidence supporting that there may be weaker connections between lemma and phonological representations in L2 compared to L1 with increased competition across co-activated phonological representations in L2 in the case of a name relation between the instrumental verb and noun.

CONCLUSION

In conclusion, the analyses of the linguistic performance of brain-damaged patients have provided important insights into how the languages are represented in the brain. According to Paradis (1994), the different forms of acquisition that underlie L1 and L2, the former based on conversational and spontaneous speech and the latter follows formal learning exercise an important influence on this organization. While L1 is assumed to involve the basal ganglia and cerebellum, L2 appears to engage the cerebral cortex. In addition, evidence supporting these assumptions has been provided by patients affected by bilingual aphasia (e. g., Aglioti & Fabbro, 1993, García-Caballero et al., 2007). Moreover, recent studies have proved that proficiency level seems to be an organizational principle of languages in the brain in the sense that, proficient languages shared common brain areas (e. g., Hernández et al., 2000).

In addition, Paradis (2001) claimed that analysing the linguistic performance of aphasic patients in different languages may provide useful insights into the diagnosis of aphasia and subsequent treatment. In recent years, the grammatical class-specific deficit reported in monolingual aphasics has received much attention in the field (e. g., Caterina Silveri et al., 2003, Daniele et al., 1993, Hillis et al., 2006). Moreover, impairment in producing nouns has been considered a distinctive symptom of SD, while difficulties in naming verbs lead to inability to produce sentences which has been especially observed in patients affected by PPNFA.

Interestingly, this grammatical category specific deficit has been recently reported in bilingual aphasia, affecting similarly both languages, which proves not to be language specific (e. g., Hernández et al. 2008). Furthermore, the locus of this deficit has been claimed to lie as impairment at the semantic level. Nevertheless, patients showing modality specific deficits have shown that they could access the meaning of the words they were unable to name. Hence, grammatical class is presented as potential organizational principle for lexical and importantly for orthographic/phonological representations (e. g., Hillis & Caramazza, 1991). Hence, this modality specific deficit may be explained as impairment to the access to phonological and orthographic representations.

Finally, it is worth mentioning that further research centered on the noun-verb dissociation should address whether linguistically different languages would be organized by the same grammatical principles (Hernández et al., 2007)

Bibliografía

- Aglioti, S., & Fabbro, F. (1993). Paradoxical selective recovery in a bilingual aphasic following subcortical lesions. *NeuroReport 4 (12),* 1359-1362.
- Bak, T. H., O'Donovan, D. G., Xuereb, J. H., Boniface, S., & Hodges, J. R. (2001). Selective impairment of verb processing associated with pathological changes and Brodmann areas 44 and 45 in the motor neurone disease-dementia-aphasia syndrome. *Brain 124*, 103-120.
- Berndt, R. S., Haendiges, A. N., Mitchum, C. C., & Sandson, J. (1997). Verb retrieval in aphasia. *Brain and Language 56,* 107-137.
- Caramazza, A., & Hillis, A. E. (1991). Lexical organization of nouns and verbs in the brain. *Nature 349,* 788-790.
- Caterina Silveri, M. C., Perri, R., & Cappa, A. (2003). Grammatical class effects in brain-damaged patients: Functional locus of noun and verb deficit. *Brain and Language 85,* 49-66.
- Damasio, A. R., & Tranel, D. (1993). Nouns and verbs are retrieved with differently distributed neural systems. *Proceedings*

of the National Academy of Sciences of the United States of America 90 (11), 4957-4960.

- Daniele, A., Silveri, M. C., Giustolisi, L., & Gainotti, C. (1993). Category-specific deficits for grammatical classes of words: Evidence for possible anatomical correlates. *Italian Journal of Neurological Sciences 14,* 87-94.
- Fabbro, F. (2001). The bilingual brain: Bilingual aphasia. *Brain and Language 79,* 201-210.
- Fabbro, F. (2001). The bilingual brain: Cerebral representation of language. *Brain and Language 79,* 211-222.
- García-Caballero, A., García-Lado, I., González-Hermida, J., Area, R., Recimil, M. J. , Juncos Rabadán, O. , Lamas, S. et al. (2007). Paradoxical recovery in bilingual patient with aphasia after right capsuloputaminal infarction. *Journal of Neurology, Neurosurgery and Psychiatry 78,* 89-91.
- Hernandez, A. E., Martinez, A., & Kohnert, K. (2000). In search of the language switch: An fMRI study of picture naming in Spanish-English bilinguals. *Brain and Language* 73, 421-431.
- Hernández, M., Costa, A., Sebastián-Gallés, N., Juncadella, M., & Reñé, R. (2007). The organisation of nouns and verbs in bilingual grammatical category-specific deficit. *Journal of Neurolinguistics 20,* 285-305.
- Hernández, M., Caño, A., Costa, A., Sebastián-Gallés, N., Juncadella, M., & Gascón-Bayarri, J. (2008). Grammatical category-specific déficits in bilingual aphasia. *Brain and Language 107*, 68-80.
- Hillis, A. E., Tuffiash, E., & Caramazza, A. (2002). Modality-specific deterioration in naming verbs in nonfluent primary progressive aphasia. *Journal of Cognitive Neuroscience 14 (7),* 1099-1108.
- Hillis, A. E., Oh, S., & Ken, L. (2004). Deterioration of naming nouns versus verbs in primary progressive aphasia. *Annals of Neurology 55,* 268-275.
- Hillis, A. E., Heidler-Gary, J., Newhart, M., Chang, S., Ken, L., & Bak, T. H. (2006). Naming and comprehension in primary progressive aphasia: The influence of grammatical word class. *Aphasiology 20 (2/3/4),* 246-256.
- Ijalba, E., Obler, L. K., & Chengappa, S. (2005). Bilingual aphasia. In T. K. Bhatia, & W. C. Ritchie (Eds.), *The Handbook of Bilingualism* (pp. 71-89). Blackwells.
- Kambanaros, M., & van Steenbrugge, W. (2006). Noun and verb processing in Greek-English bilingual individuals with anomic aphasia and the effect of instrumentality and verb-noun relation. Brain and Language 97, 162-177.
- Laka, I. & Erriondo Korostola, L. (2001). Aphasia manifestations in Basque. *Journal of Neurolinguistics 14,* 133-157.
- Lorch, M. (2007). Bilingualism and memory: Early 19th century ideas about the significance of polyglot aphasia. *Cortex 43*, 658-666.
- Pardis, M. (1977). Bilingualism and aphasia. In H. Whitaker, & H. A. Whitaker (eds.), *Studies in Neurolinguistics,* vol. 3, (pp. 65-121). New York: Academic Press.
- Paradis, M. (1994). Neurolinguistic aspects of implicit and explicit memory. Implications for bilingualism and SLA. In N. C. Ellis (Ed.), *Implicit and Explicit Language Learning* (pp. 393-419). Academic Press.
- Paradis, M. (2001). The need of awareness of aphasia symptoms in different languages. *Journal of Neurolinguistics 14,* 85-91.
- Shapiro, K. A., Pascual-Leone, A., Mottaghy, F. M., Gangitano, M., & Caramazza, A. (2001). Grammatical distinctions in the left frontal cortex. *Journal of Cognitive Neuroscience 13 (6),* 713-720.
- Wong, P. C. M. (2006). Bilingualism and aphasia. In K. Brown (Ed.), *Encyclopedia of Language and Linguistics Second Edition* (pp.12-16). Oxford: Elservier.