



## REVIEW ARTICLES

# Bilingualism and the Brain: Myth and Reality

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### KEYWORDS

Neurolinguistics;  
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### Abstract

**Introduction:** The description of bilingual aphasic patients goes back to the 19th century. Since then, the study of the relationship between bilingualism and the brain has questioned whether the neuroanatomical representation of two languages in the same brain is similar or different. The answer to this question has generated erroneous interpretations based on the results of the investigations carried out on this topic.

**Development:** The present paper will try to distinguish between myth and reality of the following statements: *a)* the neuroanatomical organization of language in bilinguals is different from that of monolinguals, and *b)* language is less lateralized in bilingual speakers.

**Results:** There is no reason to believe in the existence of qualitative differences in the cerebral organization of language between bilinguals and monolinguals. It is most likely that two languages are represented as different microanatomical subsystems in the same cerebral regions.

**Conclusions:** The differences are quantitative rather than qualitative, that is, the degree of participation of the different neurofunctional mechanisms involved in the use of language, such as metalinguistic knowledge and implicit linguistic competence.

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### PALABRAS CLAVE

Neurolingüística;  
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Representación del

### Bilingüismo y cerebro: mito y realidad

#### Resumen

**Introducción:** La descripción de pacientes bilingües con afasia se remonta al siglo XIX. Desde entonces, el estudio de la relación bilingüismo-cerebro se ha preguntado si la representación neuroanatómica de las lenguas que habla una misma persona es similar o

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lenguaje;  
Lateralización del  
lenguaje

diferente. La respuesta a esta pregunta ha generado interpretaciones erróneas de los resultados obtenidos en las investigaciones realizadas al respecto.

*Material y métodos:* En el presente trabajo, se describirá lo que hay de mito y de realidad en las siguientes afirmaciones: a) la organización neuroanatómica del lenguaje en el bilingüe es diferente del monolingüe, y b) la lateralización del lenguaje en el bilingüe es menor.

*Resultados:* No hay motivos para creer que haya diferencias cualitativas en la organización cerebral del lenguaje en bilingües y monolingües. Lo más probable es que las lenguas que habla una misma persona estén representadas como subsistemas microanatómicos distintos en las mismas regiones cerebrales.

*Conclusiones:* Las diferencias serían más bien de tipo cuantitativo, es decir, con relación al grado de participación de los diferentes mecanismos neurofuncionales implicados en el uso del lenguaje, entre ellos el conocimiento metalingüístico y la competencia lingüística implícita.

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## Introduction

Speaking two or more languages is a common feature for millions of people throughout the world.<sup>1,2</sup> Bilingualism is an extremely common phenomenon today and has been in existence since humanity developed a spoken language.<sup>3</sup> Despite these facts, bilingualism is a topic that still generates significant debate about the way in which two or more languages are represented in the brain. The aim of this study is to distinguish between myth and reality in the relationship between bilingualism and the brain. However, before moving on to the central topic of this work, we will briefly summarise the historical background of the study with aphasic bilingual patients.

## Bilingualism and Aphasia: Historical Background

In 1895, Jean-Albert Pitres published *Étude sur l'aphasie chez les polyglottes (Study of Aphasia in Polyglots)*, the first monographic work ever written on the alteration of language in bilingual and polyglot aphasic patients.<sup>4</sup> In his study, Pitres reviewed the literature published so far on the subject and described 7 of his own clinical cases. He identified 3 patterns of language following a brain lesion: 1) both languages are recovered simultaneously at the same rate, 2) one language is never recovered, and 3) the second language begins to recover only once the first one has been recovered. At present, these patterns are known, respectively, as parallel, selective and successive. Based on the language recovery patterns described, Pitres concluded that the language recovered first was the one the patient used more often before the lesion, regardless of whether or not it was the patient's mother tongue (this has come to be known as Pitres' law). The studies published by Paradis<sup>5,6</sup> on aphasia cases in bilinguals increase the number of ways in which a language can recover after brain injury. Other alterations described in these patients are errors associated with the mechanism that allows a person to choose which

language to use (code switching and code mixing), as well as disorders affecting the ability to translate from one language to another.<sup>7</sup> These are presented in table 1.

Many factors have been suggested as the causes of non-parallel recovery patterns, including the following: the order of acquisition of the languages,<sup>8</sup> the frequency of use before the injury,<sup>4</sup> injury location and severity<sup>9</sup> the emotional bond established with each language,<sup>10</sup> the type of bilingualism,<sup>11</sup> the level of knowledge of each language<sup>12</sup> and the structural distance between the languages spoken.<sup>13</sup> The problem is that none of these factors on their own can account for all the cases reported to date, or even the majority of them. Therefore, what makes one language recover faster or in a different way to another? This is where the legend begins.

## Myth 1. The Brains of Bilinguals Are Different From the Brains of Monolinguals

The most logical explanation for the different degrees of affectation of each language following a cerebral lesion is that the languages spoken by one individual are associated with different cortical areas. It is a myth, therefore, to think that the cerebral representation of language in bilinguals is different from that in monolinguals. The results obtained from cortical electrical stimulation<sup>12-14</sup> and the reported cases of non-parallel recovery<sup>15,16</sup> are interpreted as evidence of different neuroanatomical structures for each language within the classic language areas.

In 1978, Ojemann and Whitaker<sup>14</sup> used cortical electrical stimulation to study the performance of 2 bilingual patients in a naming task. The authors found brain areas, always within the left hemisphere (LH), that affected both languages in a similar way (Broca's area and the inferior parietal lobe) when stimulated. They also found regions that affected only one of them (the frontal lobe, Wernicke's area) when stimulated. In both cases, the representation of the second language (L2) was greater than the first (L1). These authors believed that even if two languages share

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