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The organization of multiple languages in polyglots: Interference or independence?

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Abstract

There is considerable evidence that fluent bilinguals suffer a certain degree of cross-language interference, which varies according to age of language acquisition, linguistic proficiency, and as words become more orthographically, phonologically and semantically similar. We studied and compared early bilinguals, simultaneous interpreters and monolingual controls to disentangle the effect of age of language acquisition from that of fluency, in the functional organization of the multilingual brain. The data suggest that a certain degree of interference takes place in the context of multiple languages because of the parallel access to different linguistic systems. There is less interference if one of the languages has a special status. Age of acquisition seems to be more relevant than proficiency in determining a different linguistic cerebral organization between monolinguals and polyglots. It appears that the linguistic systems (L1, L2, L3, etc.), are not independent but rather are based on a common conceptual system.
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1. Introduction

One of the most highly debated issues in neurolinguistic literature is the degree of interference or autonomy of the different languages that bilinguals and polyglots know and speak. It seems that some interference does exist and that this mainly depends on the

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degree of proficiency (Frenck-Mestre & Prince, 1997; Pihko, Nikulin, & Ilmoniemi, 2002) in the various languages. Bearing in mind that around the world almost one person in three is bilingual or speaks at least one dialect besides the official language(s), it becomes important to determine whether a multilingual brain is based on a unique conceptual system or whether the foreign languages are "rooted" in relatively independent modules, to establish the role of age of acquisition of a language, and whether there is a critical age for acquiring multiple languages with comparable proficiency.

Proof of some interference mainly comes from priming tasks where the prior repetition of a word in one language (L1) influences the process of translating it into a different language (L2) (Grainger & Beauvillain, 1988; Hernandez & Reyes, 2002; Kirsner, Smith, Lockhart, King, & Jain, 1984). Facilitating and inhibitory effects due to interactions between the systems for processing L1 and L2 have been shown to occur not only at the level of semantic processing (Grainger & Beauvillain, 1988) but also at orthographic (Altenberg & Cairns, 1983; Dijkstra, Grainger, & van Heuven, 1999; Li, 1996; Thomas & Allport, 2000; Van Heuven, Dijkstra, & Grainger, 1998) and phonological levels (Grosjean, 1988; Jared & Kroll, 2001). This suggests that the different languages known are not separately implemented in the brain because automatic access is given to orthographic, phonological and semantic information even when a particular language is not being used at that moment. Obviously, high priority goes to the native language, especially if there are differences in proficiency between L1 and the other languages known (L2, L3, etc.).

The relative interference, and thus non-dependence, of verbal/symbolic and linguistic/specific thought processes introduces the problem of limited capacity of the linguistic system, especially from the broadly agreed viewpoint that the neural hardware on which it is founded is to a great extent common to the different languages (e.g., Hernandez, Martinez, & Kohnert, 2000; Illes et al., 1999; Paradis, 1996; Perani & Abutalebi, 2005). However, there may be some differences (Dehaene et al., 1997; Gomez-Tortosa, Martin, Gaviria, Charbel, & Ausman, 1995; Lucas, McKhann, & Ojemann, 2004; Proverbio, Čok, & Zani, 2002; Roux et al., 2004), especially in the degree of hemispheric lateralization, and in right hemisphere recruitment.

In this regard, Roux et al. (2004) investigated which cortical areas were involved in a task where 54 monolingual and bilingual patients, 44 of whom had left-sided damage and 10 right-sided damage were asked to read aloud. Using the intra-operative cortical stimulation technique, the cortex of these patients was directly stimulated in different regions while awake. Patients performed two naming and reading tasks in the appropriate language. Overall, no differences were found in reading or naming sites between monolingual or bilingual patients; in other words, bilingual patients did not have a different distribution of naming and reading sites compared to monolinguals. Very interestingly, in about half the bilingual patients, the authors found 13 specific recording sites for reading (over frontal, parietal or temporal regions) where the stimulation produced reading interference in one language but not in the other (L1 or L2). Notwithstanding this specificity, due to the high spatial resolution of the stimulator (1 mm electrode), L1 and L2 sensitive cortical regions were all scrambled and interspersed in an apparently chaotic organization. This study, as well as other published studies (e.g., Perani et al., 1998), show that, besides being extremely complex, the neural hardware which language comprehension is based on, is not independent for each language. Furthermore, since this study demonstrated that different parts of the cortex are needed for different

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