Structural language distance: the invisible variable in modeling the bilingual brain. An approach from Parkinson's disease

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Two models try to explain the neurocognitive basis of language in bilinguals:

The declarative/procedural model (Ullman 2001; Ullman 2001; Ullman et al. 1997; Paradis 2009; Paradis 1994) suggests two memory systems that are engaged with language. The declarative system sustains the no rule-governed levels of language, whereas the procedural system manages the rule-governed ones. The two systems operate in different brain areas, and the age of acquisition and proficiency among bilinguals are important variables.

On the other hand, the single network model (Perani & Abutalebi 2005; Abutalebi & Green 2007) argues that there is only one system with shared brain areas, even in the case of bilinguals.

Both models point out the importance of the basal ganglia in language. In the declarative/procedural model, they are involved in the procedural memory in early, high proficiency bilinguals. In the single network model, they mediate word selection for monolinguals and language selection in bilinguals. Basal ganglia are affected by Parkinson's disease from early stages.

However, both models present inconsistencies when considering the results of studies that focus on language performance in bilingual Parkinson's disease patients (Cattaneo et al. 2019; Cattaneo et al. 2015; Johari et al. 2013; Lee & van Lancker Sidtis 2020; Zanini, Tavano & Fabbro 2010; Zanini et al. 2004). Either they reveal deficits in one language or no differences between languages. A possible explanation for this phenomenon could be a variable not yet considered: structural language distance between L1 and L2. Structural language distance is different between studies, from a small distance as in the case of Catalan-Spanish, to the large distance between English and Korean.

Our hypothesis is that structural language distance is crucial for explaining language performance in L1 and L2, rather than the affectation in the basal ganglia. That is, language distance may be more relevant than the implication of a concrete brain area (basal ganglia) in bilinguals: the bigger the distance, the bigger the differences between L1 and L2.

In this study, we compared language performance in Catalan and Spanish in 8 bilingual Parkinson's disease patients. We used an adaptation of the Bilingual Aphasia Test (BAT) of Michel Paradis, which includes the following: a detailed bilingual history questionnaire which contains all variables present in the models (age of acquisition, exposure to L2, language use, proficiency) among relevant others, such as switching tendencies (also analysed in language performance, are significant for the implication of the basal ganglia); language tasks that examines all language levels (morphology, phonology, syntax and lexicosemantics) in L1 and L2; and translation tests. Furthermore, the Bilingual Aphasia Test has been adapted for more than 70 languages, which facilitates testing structural language distance in multiple language combinations.

To date, our preliminary results show no significant differences between L1 and L2 performance in Catalan-Spanish speakers, which challenges the models' hypotheses. The lack of significant differences in L1 and L2 among the multiple language levels could be due to small language distance. Further research is needed to compare linguistic performance in language pairs with different structural language distances, also considering the influence of the traditional variables on bilingualism.

Will structural language distance become a significant variable to consider when modeling language and cognition?

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