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Research paper

# Language deterioration in bilingual Alzheimer's disease patients: A longitudinal study

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ABSTRACT

In the context of bilingual research, little is known about the effects of neurodegenerative disorders (NDs) on the processing of two languages in a bilingual. In a recent cross-sectional study, we showed that Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD) had similar effects on lexico-semantic processes in the two languages of highly proficient bilinguals (Costa et al., *Neuropsychologia*, 2012, 50, 740–53). In the present longitudinal study, we extend this finding by looking at the pattern of language deterioration over time in the same population of Catalan-Spanish bilingual patients. All the participants completed three language-processing tasks (picture naming, word translation and word comprehension), both in their dominant (L1) and non-dominant (L2) language. At one year, the final group was made up of 50 patients: 15 with MCI and 35 with AD. For AD but not MCI, the language deterioration over time was the same in both languages, as previously reported in the cross-sectional study. The results are discussed in the frame of the hypothesis of shared lexico-semantic processing in highly proficient bilinguals and the influence of executive control deficits in language production.

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## 1. Introduction

The way in which brain disease affects the two languages of a bilingual has been the subject of research in the field of bilingualism for a long time. A growing body of research has focused on defining the pattern of language recovery after acquired brain damage, such as that caused by vascular diseases or tumours. Surprisingly, there has been little research on the impacts of such damage on people with age-related disorders, including neurodegenerative diseases (NDs). The study of NDs

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offers a good opportunity to examine how languages decline over time as the cognitive impairment progresses. Moreover, the increased prevalence of such diseases (Alzheimer's Disease Association, 2015), with the incidence increasing due to an increase in life expectancies, further motivates research in this area.

In the context of language deterioration in bilingual speakers, Alzheimer's disease (AD) is one of the most studied ND. The interest in AD is due to the fact that semantic memory, in addition to long-term episodic memory, is affected from the early stages of the disease (Adlam, Bozeat, Arnold, Watson, & Hodges, 2006; Garrard, Lambon Ralph, Patterson, Pratt, & Hodges, 2005; Hodges & Patterson, 1995; Rogers, Ivanoiu, Patterson, & Hodges, 2006; Salmon, Shimamura, Butters, & Smith, 1988). The well-documented deficit of word finding in AD patients has been attributed to impaired lexical/semantic retrieval and/or a breakdown of semantic word representations (e.g., Hodges, Patterson, Graham, & Dawson, 1996). Crucially, this impaired lexical retrieval has been related to the defective functioning of executive control (EC), such as monitoring, updating and inhibiting the processes at play during word selection (e.g., Taler & Phillips, 2008). Thus, studies of bilingual AD patients may shed light on how damage at the lexico-semantic level influences the word retrieval of the two languages.

The available evidence on language impairment in bilingual AD patients is mixed, with some studies reporting parallel deterioration and others reporting differential deterioration of the two languages. As shown in Table 1, most studies have included only small groups of individuals, and only one study has examined the language performance of bilingual patients with AD across time (Ivanova, Salmon, & Gollan, 2014). Longitudinal studies are preferable to cross-sectional ones because they can assess changes in the performance of individual patients over time. Moreover, the longitudinal study of the same patients assessed in an earlier cross-sectional study found that the pattern of language impairment changed, from differential at the beginning to parallel over time (Ivanova et al., 2014).

The present study consisted of a one-year follow up of the same population of bilingual patients with AD and Mild Cognitive Impairment (MCI) who were assessed in our previous cross-sectional study (Costa et al., 2012). MCI patients were included as being in the preclinical stage of AD, with an interest to see whether and to what extent the two languages decline before the dementia symptoms. Moreover, to the best of our knowledge, there are no longitudinal studies of bilingual speech production in MCI patients.

That cross-sectional study revealed parallel deterioration in both languages in the two groups of Catalan-Spanish bilingual patients, who performed three linguistic tasks involving word comprehension and production. The aim of the present study was to explore the deterioration in the two languages of these patients over time. Specifically, the study explored how the progression of the disease after one year influenced their language performance and whether the decline in the two languages was parallel. Before detailing the present study, we will briefly review the evidence of parallel and differential

**Table 1**
Type of language deterioration found in studies with bilingual AD patients.

| Authors | Languages | Age of L2 acquisition/ exposure | Participants | Tasks/measures | Language deterioration (differential vs. parallel) | Dominant/non-dominant language |
|---|---|---|---|---|---|---|
| *Cross-Sectional Studies* | | | | | | |
| Friedland and Miller (1999) | English and Afrikaans | 12 yo | AD (n = 4) | Spontaneous speech/ conversation | Differential | Non-dominant |
| Mendez et al. (1999) | Different languages and English | 13 yo | AD (n = 31) | Conversational speech (Caregivers report) | Differential | Non-dominant |
| de Picciotto and Friedland (2001) | English and Afrikaans | 7 yo | Healthy elderly (n = 30), AD (n = 6) | Semantic fluency | Differential | Non-dominant |
| Meguro et al. (2003) | Japanese and Portuguese | – | AD (n = 4) | Picture naming, Reading, Word comprehension, Lexical decision | Differential | Non-dominant |
| Salvatierra et al. (2007) | English and Spanish | ~20 yo | Healthy elderly (n = 11), AD (n = 11) | Semantic and Phonemic fluencies | Parallel | |
| Gollan et al. (2010) | English and Spanish | Spanish-dominant: AD ~ 33 yo; Elderly ~ 31 yo | Healthy elderly (n = 42), AD (n = 29) | Picture naming (Boston Naming Test) | Differential | Dominant |
| Gomez-Ruiz et al. (2012) | Catalan and Spanish | <5 yo | Healthy elderly (n = 12), AD (n = 12) | Bilingual Aphasia Test | Parallel | |
| Costa et al. (2012) | Catalan and Spanish | <6 yo | MCI (n = 24), AD (n = 47) | Picture naming, Word translation, Word comprehension | Parallel | |
| *Longitudinal study* | | | | | | |
| Ivanova et al. (2014) | English and Spanish | English-dominant: birth; Spanish-dominant: AD ~ 14 yo; Elderly ~ 24 yo | Healthy elderly (n = 14), AD (12) | Picture naming (Boston Naming Test) | Differential | Non-dominant |

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