Task- and Strategy-driven Neurofunctional Reorganization for Verbal Fluency in Normal Aging

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Introduction

Language abilities are among the most preserved cognitive abilities in aging. As it is the case for other cognitive abilities, the preservation of language abilities in aging is sustained by neurofunctional reorganization (Cabeza et al., 2002). Some language abilities, such as verbal fluency (VF), are more diverse in the way they are approached by the participant as lexical stock increases with age, as well as in the way they make use of different processes namely clustering (i.e., producing words from the same semantic or orthographic sub-category) and switching (i.e., shift of word between different clusters). The aim of this study is to describe the functional age-related changes that occur in the brain for the strategic processes involved in VF using fMRI.

Method

Twelve healthy young (20-35 years) and twelve healthy old high-educated adults (60-75 years) participated in this study. Using functional magnetic resonance imaging, participants were asked to generate, overtly and self-paced, words from four semantic categories (animals, vegetables, clothing, sports) and four orthographic categories (L, M, V, P), alternated with a control condition in which months of the year were generated repeatedly. Blocks of conditions were presented randomly in which a cue was presented for 90 sec indicating the condition. Participants had then 90 sec to generate as many words they could come up with.

Results

No significant differences were observed between younger and older participants in terms of number of clusters and switches. However, fMRI analyses revealed a difference in the pattern of brain activation according to age and the component of the task (clustering vs switching). During clustering, older participants showed significant bilateral temporal activations, while younger participants showed a significant bilateral activation of fronto-striatal regions. During switching, older participants showed unilateral activation of temporal regions, while unilateral activation of fronto-striatal regions was observed in younger participants.

Conclusions

Distinctive neurofunctional reorganization in VF occurring in aging has been described. In general, fronto-striatal activation was observed in younger participants, while older participants activated the temporal regions. The nature of this neurofunctional reorganization appears to express distinct strategies used according to age where older participants appear to rely more on their richer lexical stock, as there is more bilateral activation of temporal regions.
Younger participants appear to rely more on the use of exploration strategies, as there is more unilateral activation of less specifics to language frontal regions. Thus for younger participants, the fronto-striatal regions seem to be more implicated than temporal regions. This antero-posterior shift patterns in aging can appear to be compatible with the idea that distinctive neurofunctional reorganization, expressing distinctive strategies are necessary in order to maintain similar performance in VF (Cabeza et al., 2002). This result could have an impact on the nature of the language disorders resulting from comparable brain lesions according to age.

References