ATTENTION INHIBITORY PROCESS DECLINE DURING LIFE SPAN: A FUNCTIONAL MRI STUDY

A. MATHIS[1]
[1]NMR unit, FORENAP, ROUFFACH, France

Introduction

Attention inhibitory process is known to be sensitive to aging and several previous neuroimaging studies have described Elderly greater activation in the left prefrontal cortex (PFC) compared to Young subjects during selective attention tasks. Two major hypotheses are invoked to explain this age-related change in brain activity pattern. According to the compensatory hypothesis (Cabeza, 2002), this increase of cortical activity permits to overcome brain aging and to avoid cognitive loss. According to the dedifferentiation hypothesis (Li et al., 2001), this change in brain activity pattern is related to a loss of specificity of PFC areas which is not beneficial to subject's performances. In the present study we assessed the contribution and the emergence of dedifferentiation and/or compensation process in young, middle-aged and elderly subjects performing a selective attention task, during a functional magnetic resonance imaging (fMRI).

Material and methods

Three groups of subjects were constituted: Young; mean age of 26.8 ± 2.8 years, Middle-aged; mean age of 50.8 ± 2.8 years, Elderly; mean age of 62.3 ± 2.9 years. The selective attention task used was an adapted word colour-matched Stroop task consisting in to identify the printing colour of a word. Three conditions were defined depending on the meaning of this word; no meaning: "neutral", colour word matching to the printing colour: "congruent", colour word mismatching to the printing colour "incongruent". Differences in cortical activity between neutral and both congruent and incongruent conditions were assessed for all groups and for each contrast and the percentage of signal change has been calculated in regions of interest localized in every activated cortical area of groups' maps.

Results

Reaction times and accuracy were similar between both elderly and middle-aged subjects but weaker and slower compared to young subjects across all conditions. Only the signal variation extracted from regions of interest localized in left ventrolateral PFC (VLPFC) and dorsolateral PFC (DLPFC) reveal an age-related effect (Figure 1). The signal variation in both regions was greater for elderly compared to young subjects ($p<0,05$). Moreover, middle-aged subjects showed an intermediary variation of signal in left VLPFC compared to both other groups since the percentage of signal change were greater ($p<0,05$) compared to young people for congruent condition but statistically not distinguishable from Young or Elderly groups for incongruent condition.

Discussion

During all conditions of the stroop task elderly shown lower accuracy and greater reaction times as an increase of signal in left VLPFC and DLPFC compared to young subjects. Middle-aged subjects, who performed equivalently to elderly, shown an intermediary increase of signal in left VLPFC compared to both other groups. According to a recent review of Rajah and D'Esposito (2005) both compensatory and dedifferentitation hypotheses have been used to explain these age-related changes in brain activity pattern. The VLPFC signal change seems to be due to a dedifferentiation of this ventral region since no benefit to performances were observed in middle-aged subjects compare to young subjects. Moreover this aging of ventral region seems to be already in place at fifty years old, but not as strong as in sixty years old subjects. Left DLPFC over-recruitment observed in elderly compared to middle-aged could be considered as compensatory activity since no greater impairment of cognitive functions were observed compared to middle-aged whereas it as been reported to happen in several cognitive behavioural studies.

References

Cabeza R, 2002. Hemispheric asymmetry reduction in older adults: the HAROLD model. Psychol Aging 17(1):85-100.
Li SC et al, 2001. Aging cognition: from neuromodulation to representation. Trends Cogn Sci. 5(11):479-486.
Rajah MN, D'Esposito M., 2005. Region-specific changes in prefrontal function with age: a review of PET and fMRI studies on working and episodic memory. Brain. 128(Pt 9):1964-83.

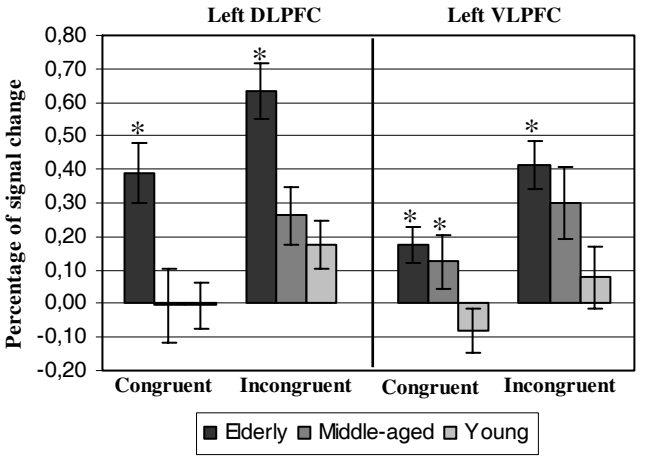

Figure 1 Percentage of signal change between neutral condition and both congruent and incongruent conditions in left dorso- and ventrolateral prefrontal cortex. Error bars are the standard error. * Significantly different from young subjects' value at $p<0,05$.