Behavioural and neural correlates of age-related speech perception deficits

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Introduction:

Among the difficulties experienced by elderly adults, a highly prevalent and disabling problem is a decline in the ability to comprehend speech, particularly in situations of degraded intelligibly. These difficulties reduce the effectiveness of communication and can lead to decreased social participation. Despite the importance of communication on quality of life, the extent of these difficulties is not well understood. Specifically, it is not clear if all speech sounds are similarly affected by aging, and if cognitive factors such as decline in attentional capacities are involved. Moreover, the brain senescence mechanisms underlying these difficulties are unclear, though we have recently shown (Bilodeau etal., 2014), that functional changes in the left anterior dorsal insula (dAI), a region that is believed to play a role in attentional control, are associated with age-related speech perception difficulties, supporting the hypothesis of a role for attentional deficit in the aetiology of these difficulties. However, in that study, auditory attention was not evaluated and we did not evaluate the effect of aging on different classes of sounds. The goals of this study, which included a behavioral and an MRI component, were thus (1) to characterize age-related changes in the ability to discriminate different speech sounds (vowels/consonants, fricative/occlusive consonants, etc.), (2) to clarify the role of attention and hearing in the aetiology of speech perception deficits; and (3) to evaluate the importance of several neurobiological markers in predicting speech deficits, particularly in the insula.

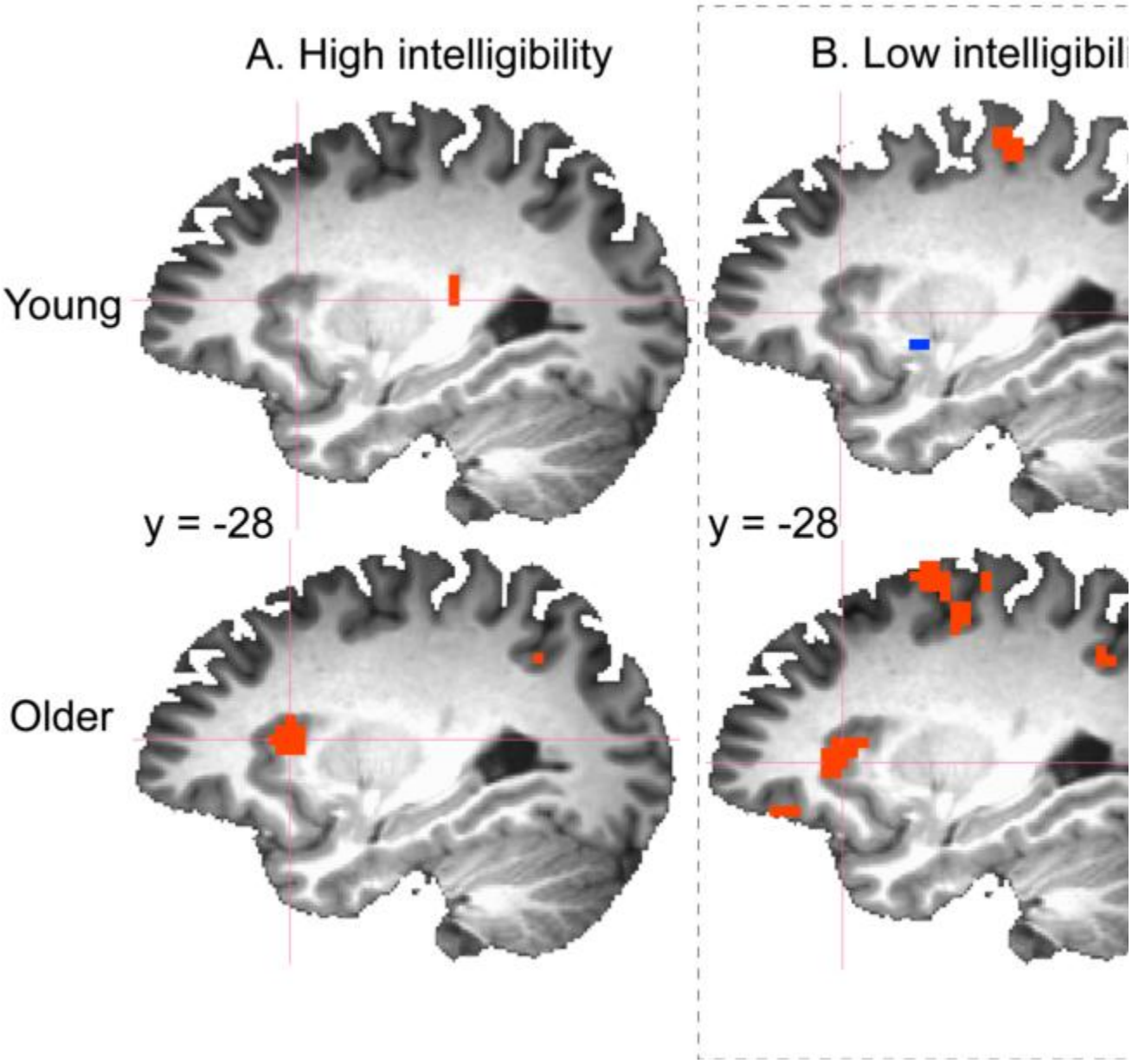
Methods:

•Our preliminary sample for the behavioral measures includes 39 healthy adults (16 males, 22-87 years, mean 55.3±17 years; the final sample will include 80 adults). Subjects completed a syllable discrimination task, a test of auditory and visual attention (The IVA), complete hearing assessments and an MRI session. Only four of these participants have been scanned (2 young, 2 older adults). The syllable discrimination task was a two-alternative forced choice task, consisting in 720 pairs of auditory syllables. Half (360) the pairs were identical, 120 had different fricative consonants (/fe/ vs. /se/), 120 had different occlusive consonants (/pe/ vs. /ge/), and 120 had different vowels (/fə/ vs. /fe/). Syllable intelligibility was manipulated by adding pink noise to the syllables to reach a dB signal-noise ratio (SNR) of either 15 (mid) or -5 (low).
•In the MRI scanner, a shorter version of the task was administered which included 144 trials. MRI data were acquired on a Philips Achieva TX 3T. Anatomical, functional and diffusion images were acquired. A sparse sampling paradigm with parallel imaging was used to collect BOLD fMRI (43

slices 3mm3, TR = 5sec, delay in TR = 2.7sev; SENSE = 2).
•fMRI data were pre-processed and analyzed with AFNI. The data were convolved with a 2 parameter SPM response model.

Results:

•Our results show that perception accuracy declines with age ($F(1,35) = 9.54$, $p = .004$), and intelligibility ($F(2,70) = 9.54$, $p = .004$). Importantly, an interaction was found between Age, Sound class and Intelligibility ($F(4,140) = 2.78$, $p = .029$), which revealed that the perception of fricative consonants was most affected by aging.
•Preliminary analyses of the BOLD signal support the notion of a role for the left dAI in supporting speech functions in aging (Figure 1). A stronger and more bilateral activation was found in older than younger adults in low intelligibility. Activation was also found in the left dAI when intelligibility was high only in the older adults.



·Figure 1

Conclusions:

The present study will provide the first comprehensive picture of the effect of age on speech perception and provide new important information about the underlying neural mechanisms. Preliminary results indicate that the left dAI may play a role in monitoring speech perception in older adults, providing evidence of a potential compensatory mechanism involving this region.

Imaging Methods:

Anatomical MRI

BOLD fMRI

Language:

Speech Perception [2]

Lifespan Development:

Aging [1]

Perception and Attention:

Perception and Attention Other

Keywords:

Aging

Cognition

FUNCTIONAL MRI

Language

[1|2]Indicates the priority used for review

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Please indicate below if your study was a "resting state" or "task-activation" study.

Task-activation

Healthy subjects only or patients (note that patient studies may also involve healthy subjects):

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Yes, I have IRB or AUCC approval

Please indicate which methods were used in your research:

Functional MRI

For human MRI, what field strength scanner do you use?

3.0T

Which processing packages did you use for your study?

AFNI

Provide references in author date format

Bilodeau-Mercure, M., C. L. Lortie, M. Sato, M. J. Guitton and P. Tremblay (2014). "The neurobiology of speech perception decline in aging." Brain Struct Funct.