I. INTRODUCTION
Speech perception difficulties are common amongst elders; yet the underlying neural mechanisms are still poorly understood. New empirical evidence suggests that brain senescence may be an important contributor to these difficulties. Understanding age-related vulnerabilities of the neural speech processing system is critical to developing new intervention strategies to maintain communication throughout aging. Here we investigated the relationship between structural and functional brain senescence and speech perception skills in aging.

II. MATERIAL & METHODS

1. Participants: see Table 1.

2. Hearing assessment: (1) pure tone audiometry, (2) speech recognition threshold and (3) distortion product oto-acoustic emissions recording (DPOAEs) (Fig. 4-5).


4. Task: participants’ task was to repeat the stimuli as quickly as possible. Subjects’ verbal responses were recorded using a high quality MRI compatible optical microphone.

5. MRI data acquisition:
   - Philips 3.0 Tesla Achieva TX.
   - 108 Single-shot EPI BOLD functional images with sparse sampling parallel acquisition technique (40 interleaved slices (3 mm3, no gap); SENSE = 2; TR = 6000 ms; acquisition time = 2140 ms, delay in TR = 3860 ms; TE = 30 ms; FOV = 240 mm 2; 80 x 80 matrix).
   - All stimuli were presented during the delay in TR (see Fig. 2).

6. MRI data analyses:
   - Pre-processing and data analyses were done in AFNI/SUMA. All analyses were controlled for hearing differences using right ear PTA and right ear DP-OAEs as covariates and corrected for multiple comparisons using a Monte Carlo procedure. Analyses included: 1. Conjunction of all intelligibility levels for each subject (Fig. 7) 2. Group-level permutation corrected ANCOVA to examine the effect of age and intelligibility on BOLD (Fig. 8-9); 3. Cortical thickness analyses focusing on the effect of age (Fig. 10); 4. ROI-based mediation analyses to link behavioural, thickness and BOLD data (Fig. 11).

III. RESULTS & DISCUSSION

- Speech accuracy decreased as a function of intelligibility and age after controlling for hearing differences and sex (F(2,34) = 4.54, p = .018) (Fig. 6).
- Several cortical regions including the right supramarginal gyrus, posterior right insula, left anterior insula, right medial prefrontal cortex, left precentral gyrus and sulcus were thinner in older adults.
- The core speech network decreases in spatial extent in older adults (Fig. 7). This decline had a beneficial indirect effect on the relationship of age to performance. Age-independent intelligibility effects on BOLD signal were found in several motor and premotor areas, including the left ventral premotor cortex and the right SMA (Fig. 8).
- Age-dependent intelligibility effects were also found, mainly in sensorimotor areas, and in left anterior insula (Fig. 9).
- In the left anterior insula we found a detrimental indirect effect on the relationship of age to accuracy through BOLD signal magnitude (Fig. 10). This suggests a role for this region in maintaining speech perception in older ages.
- One of the most intriguing finding of this study is the relative dissociation between functional and structural aging (Fig. 11).

IV. CONCLUSIONS
In conclusion, we demonstrated important age-related structural and functional neural differences associated with speech perception not accounted for by peripheral hearing loss, which demonstrate the importance of neurobiological factors in the aetiology of age-related speech difficulties.