Age Differences in Connectivity and Structure of an Individually Defined Dual-Task Network

Lya K. Paas Oliveros[1,2,4], Edna C. Cieslik[1,2], Dan Hu[4], Rachel N. Pläschke[2], Xiaolong Peng[4], Catherine S. Hubbard[4], Simon B. Eickhoff[1,2], Hesheng Liu[3,4], & Robert Langner[1,2].

[1] Institute of Neuroscience and Medicine (INM-7: Brain and Behaviour), Research Center Jülich, Jülich, Germany; [2] Institute of Systems Neuroscience, Heinrich Heine University Düsseldorf, Düsseldorf, Germany;
[3] Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, USA;
[4] Department of Neuroscience, Medical University of South Carolina, Charleston, SC, USA; l.paas.oliveros@fz-juelich.de

Introduction

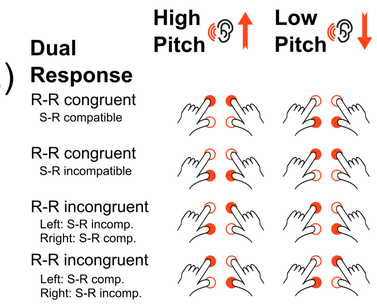
- **Dual-tasking** has been associated with increased fronto-parietal activity [1], and difficulties in performance are exacerbated in **advanced age** [2-4].
- No two individuals are alike → **Inter-individual differences in the organization of functional brain systems** may be informative in the understanding of age-related difficulties in dual-tasking.

➢ **Aim:** To assess **age differences** in functional connectivity (FC) and structural parameters of a **dual-task network with individual-specific topology**.

Methods

➢ Participants after quality control (n = 102 → n = 71):

41 young adults (21 ♀, Ø 25.6 ± 3.4 y.o.) | **30 older** adults (12 ♀, Ø 61.9 ± 5.8 y.o.)



➢ Individualized parcellation:

- To account for **inter-individual variability in functional organization** [5,6]:

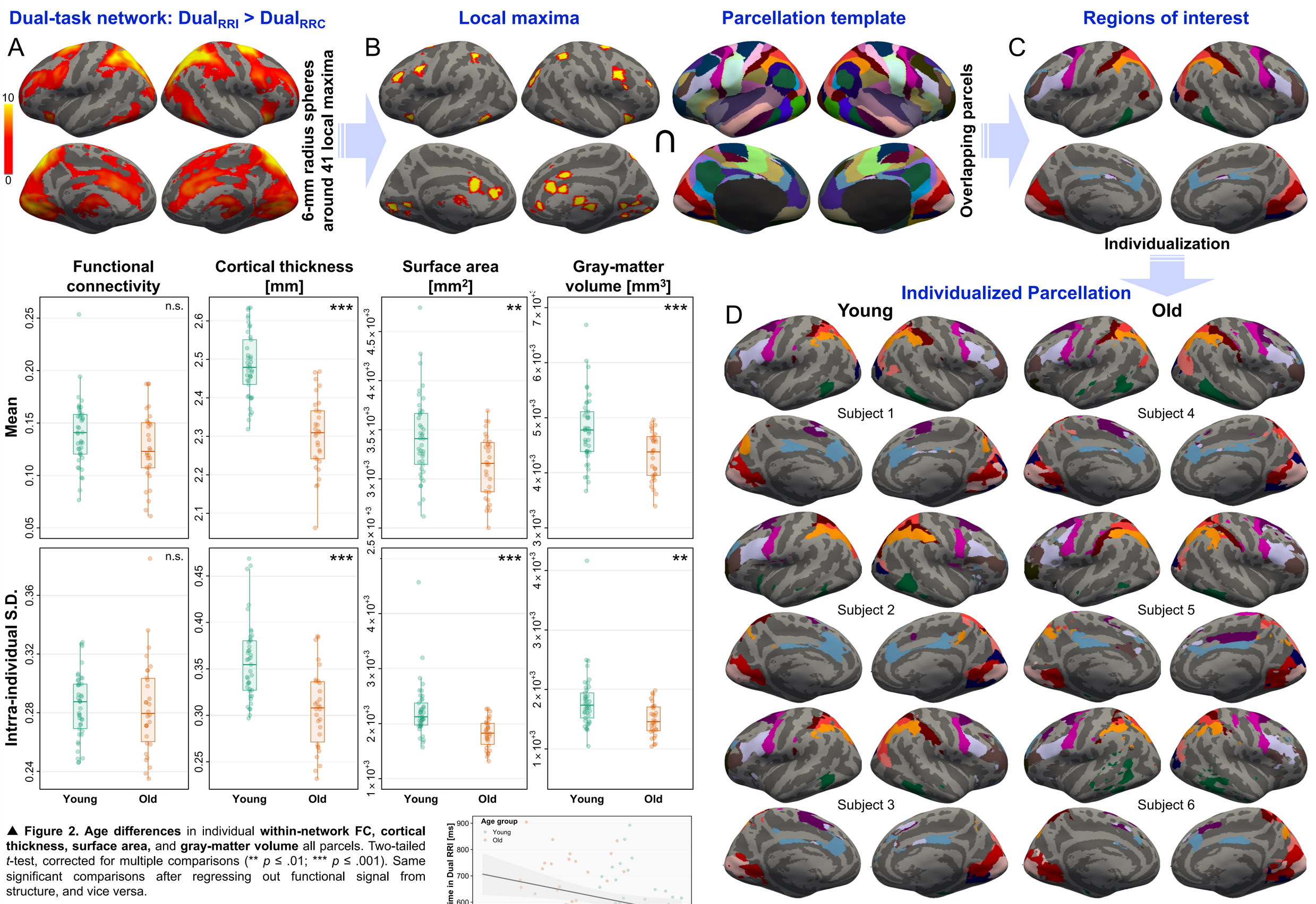
rs- and tb-fMRI data acquired during same session → Individual iterative cortical parcellation approach → Map **92 discrete and homologous functional regions** based on voxel-level connectivity patterns

➢ Dual-task network and analysis:

- **Single-stimulus onset dual-response fMRI paradigm** [4,7-8] ➔ **GLM: $Dual_{RRI}$ > $Dual_{RRC}$** contrast to obtain **dual-task activation map** → 6-mm radius spheres around 41 local maxima → Register into surface space to extract **overlapping parcels** from the 92 functional regions ➔ **25 parcels**
- **Age-group comparison** of **individual within-network FC, cortical thickness**, **surface area**, and **gray-matter volume** across the parcels of interest **[mean; S.D.]**. Control analysis: Regressed out functional signal from structure, and vice versa.
- **Association** of FC and structural parameters with **dual-task performance**.

RRC: Response–Response congruent
RRI: Response–Response incongruent

Results



▲ **Figure 2. Age differences** in individual **within-network FC, cortical thickness, surface area,** and **gray-matter volume** all parcels. Two-tailed *t*-test, corrected for multiple comparisons (** $p \leq .01$; *** $p \leq .001$). Same significant comparisons after regressing out functional signal from structure, and vice versa.

▲ **Figure 1. (A) Dual-task activation map**. **(B)** 6-mm radius spheres around the 41 local maxima were overlapped with the 92 template functional regions. **(C)** Individualized functional and structural metrics were extracted from **25 regions** (12 in the left hemisphere, and 13 in the right) for each participant. **(D) Individualized parcellation** of the **dual-task network** from **three young** and **three older** participants.

▶ **Figure 3.** Correlation between mean cortical thickness and dual-task speed.

Discussion

- Healthy **older (vs. younger) adults** present **structural deterioration** in key regions of a dual-task network with individualized topology, **independent of FC variations** → Expected due to **neurodegenerative processes** that come with age.
- However, individual differences in dual-task performance were not explained by variability in regional structural characteristics of the network.
- No age-related differences nor associations with performance in **within-network functional connectivity**
  → Might be due to the overall within-network analyses.

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