Predicting dual-task performance from individualized functional and structural networks

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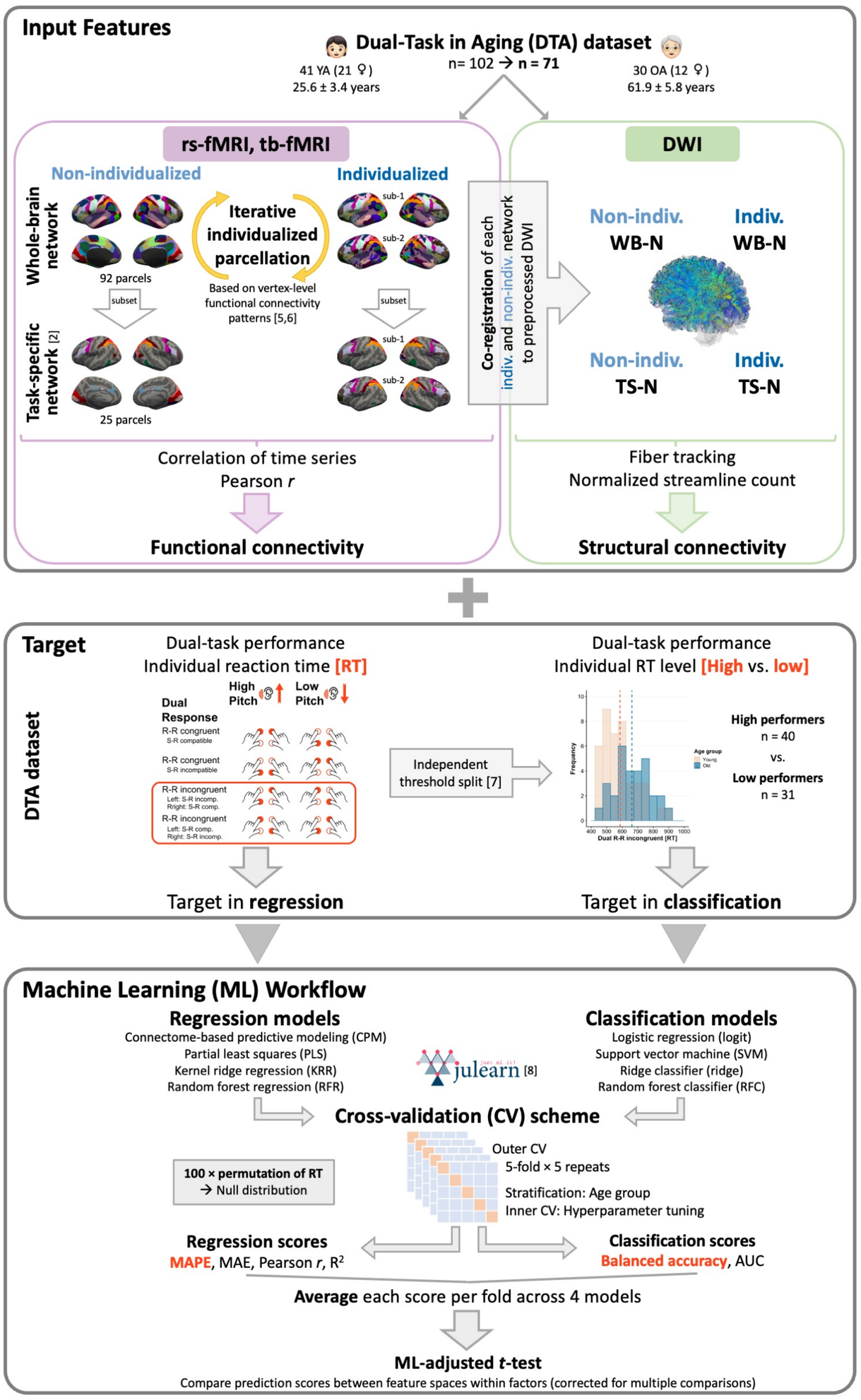
Introduction

- **Dual-tasking** has been associated with increased fronto-parietal activity [1,2].
- **Functional and structural connectivity (FC and SC)** display unique features relevant to cognition; however, predictions studies show overall **low accuracies** [3,4].
- Accounting for **inter-individual variability** in macroscopic brain organization may be informative for elucidating **brain-behavior associations** at the individual level [5,6].

➢ **Aim 1:** To assess to what extent we can **predict dual-task performance** from **FC** and **SC** in **individualized task-specific and whole-brain networks** (**TS-N and WB-N**, respectively).

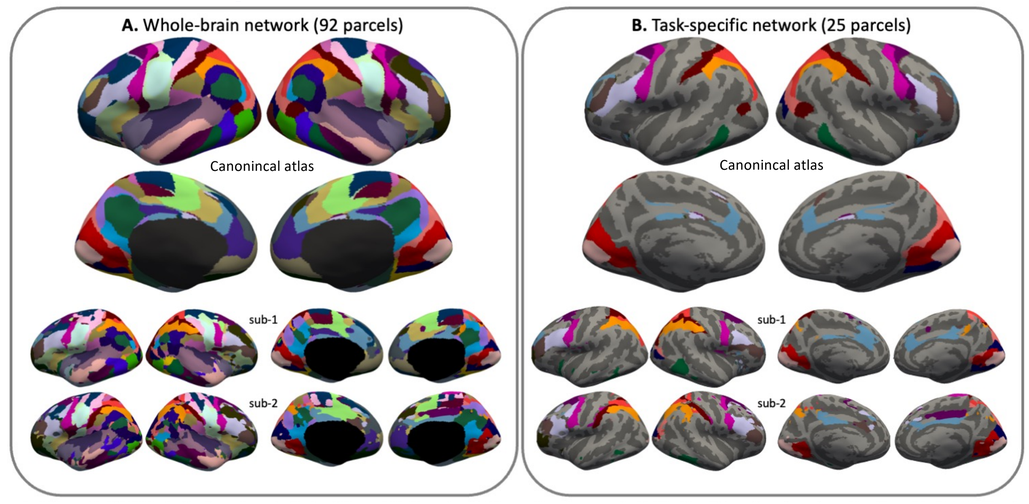
➢ **Aim 2:** To assess to what extent we can **classify dual-task performance level** from FC and SC in individualized TS-N and WB-N.

Methods

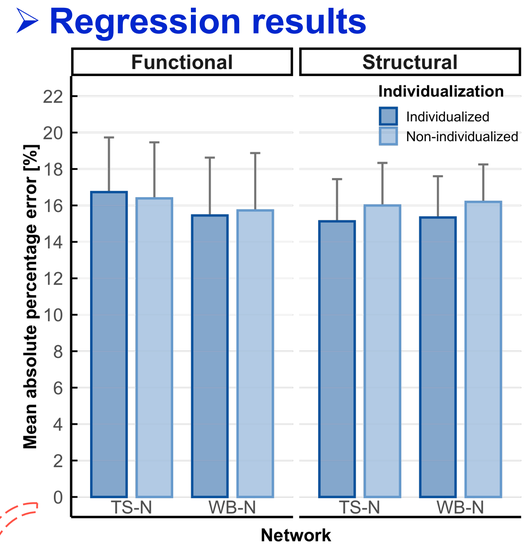


Results

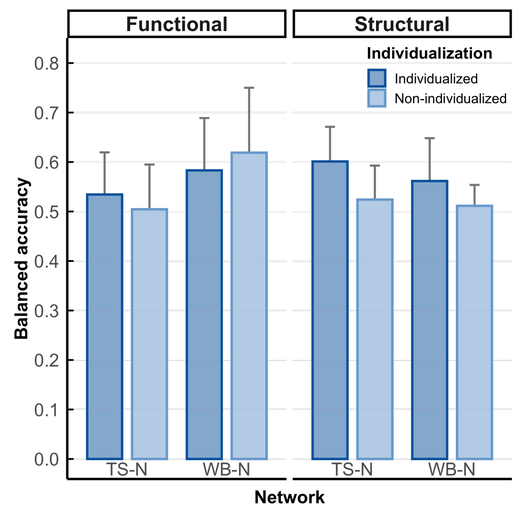
➢ Individualized parcellation



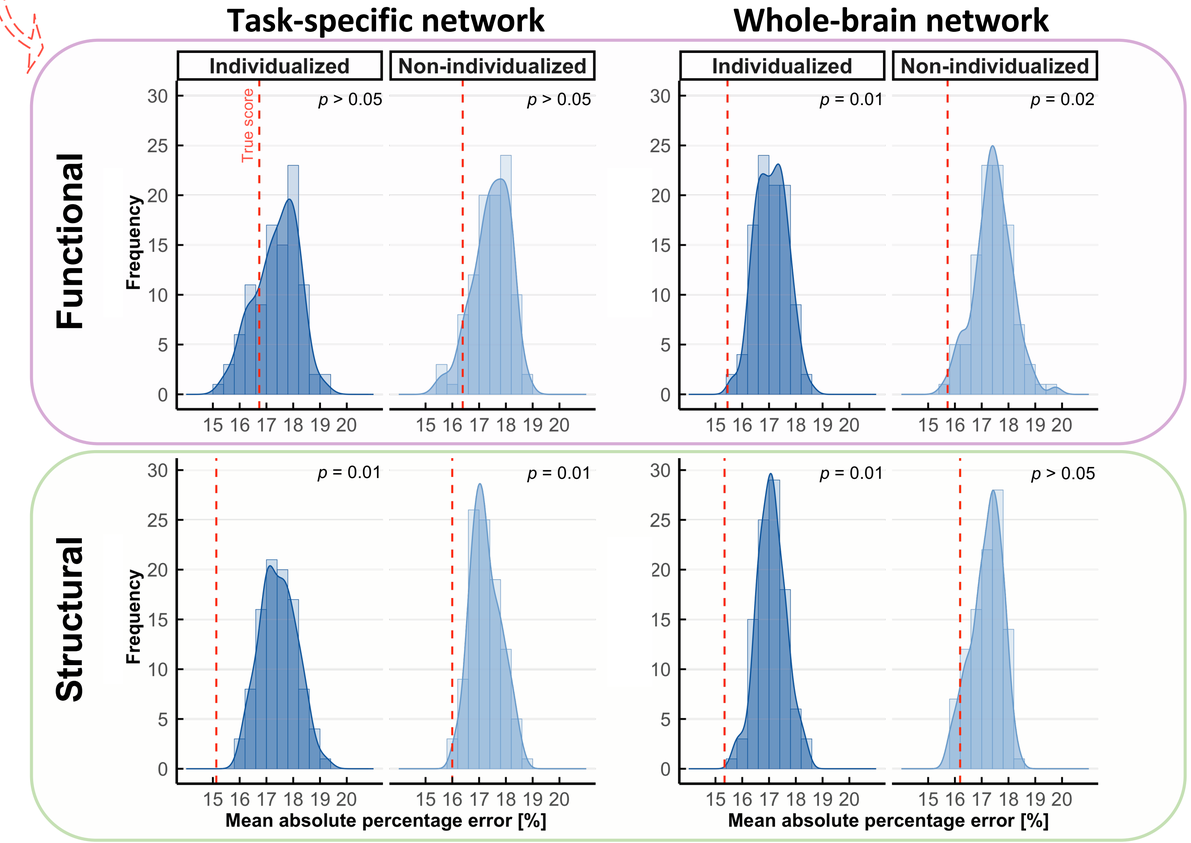
➢ Regression results



➢ Classification results



➢ Permutation results (100 × permutations)



Discussion

- **Regression:** Higher prediction accuracy with **individualized** and **structural** networks; especially comparing individualized FC and SC in task-specific networks.
- Functional WB-N outperformed TS-N → **relevance of global brain organizational properties** in brain-behavior associations [9,10]. Especially, functional TS-N is limited in explaining variance of dual-task performance (vs. null distribution).
- **Classification:** **Structural connectome** follows similar pattern as with regression; however, functional non-individualized WB-N appears to outperform TS-N.
- Are fluctuating functional as well as stable structural brain connectomes overall limited in explaining large variance of cognitive performance → **Granularity mismatch** [11]?
- Findings in line with previous cognitive prediction studies with low accuracies [4,9,10].
- Only **slight (non-significant) improvement** in prediction accuracy when **accounting for inter-individual variability in the brain's functional organization** [5,6].
- **Outlook:** Replication with larger sample, further research integrating multi-modal brain features and comparing diverse individualization approaches.

References **[1]** Worringer, B, et al. (2019) *Brain Struct Funct*, 224:1845–69. **[2]** Paas Oliveros, LK, et al. (in press) *Cereb Cortex*. **[3]** Dhamala, E, et al. (2021) *Hum Brain Mapp*, 42:3102–3118. **[4]** Krämer, C, et al. (2023) *GeroScience*. **[5]** Wang, D, et al. (2015) *Nat Neurosci*, 18:1853–60. **[6]** Li, M, et al. (2019) *PLOS Biol*, 17:e2007032. **[7]** Paas Oliveros, LK, et al. (2023) *Psychol Res*, 87:260–280. **[8]** JuLearn: https://juaml.github.io/julearn/ **[9]** Heckner, MK, et al. (2023) *Cereb Cortex*. **[10]** Pläschke, R, et al. (2020) *Cortex*, 132:441–459. **[11]** Krakauer, JW, et al. (2017) *Neuron*, 93:480–490.

Acknowledgments: This study was supported by the Deutsche Forschungsgemeinschaft (DFG, LA 3071/3-1, SFB 1451), the National Institute of Mental Health (R01-MH074457), the Helmholtz Portfolio Theme Supercomputing and Modeling for the Human Brain, and the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement No. 945539 (HBP SGA3), and a German Academic Exchange Service (DAAD) Scholarship.