Structural correlates of visuospatial and verbal working memory

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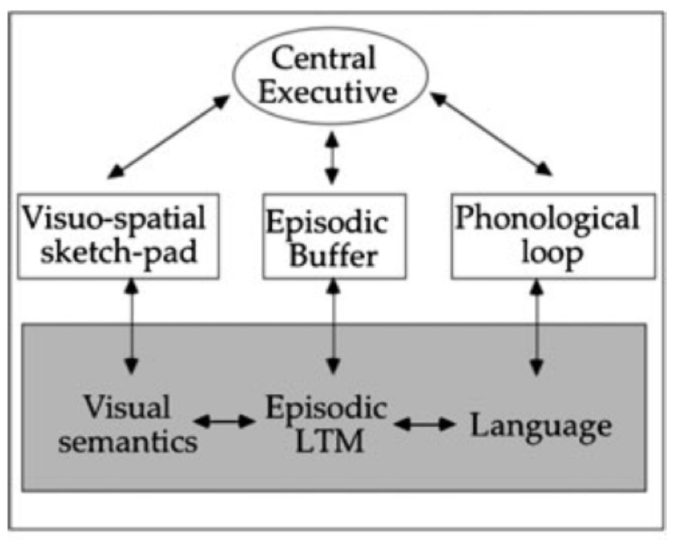
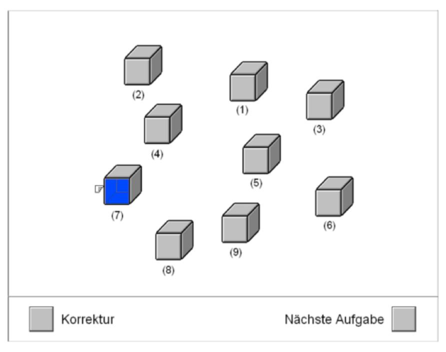
Introduction

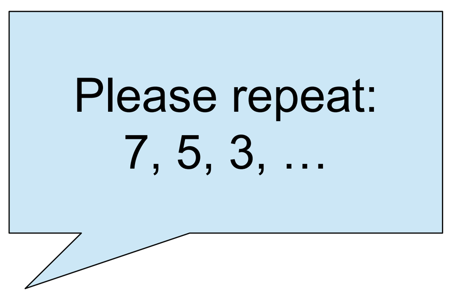
- **Working memory** (WM): ability to store and manipulate information for a short period of time
- Measured by span tasks
  - increasingly longer sequences of stimuli have to be recalled in same or reversed order as presented
- **CORSI block tapping task** and **digit span task** to assess **visuospatial** and **verbal** subcomponents
- Structural underpinnings of WM remain unclear



Multi-component model of working memory, adapted from Baddeley, 2000

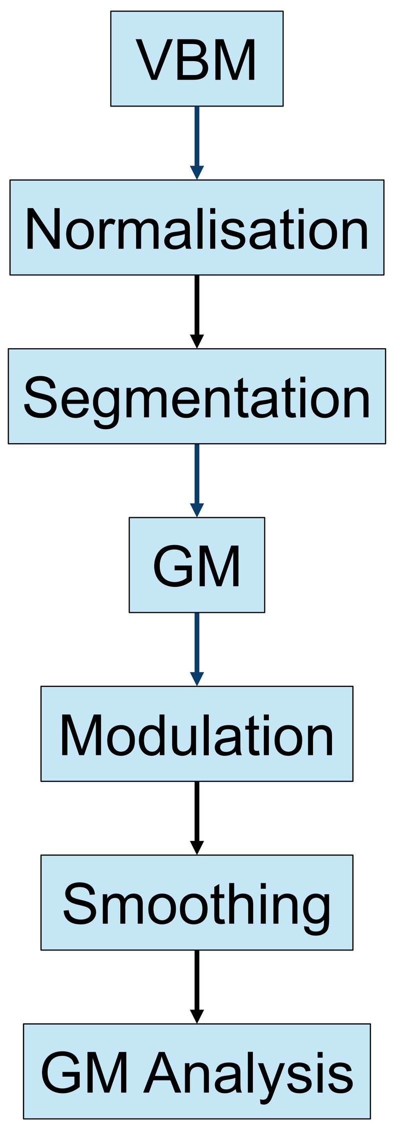


CORSI block tapping task

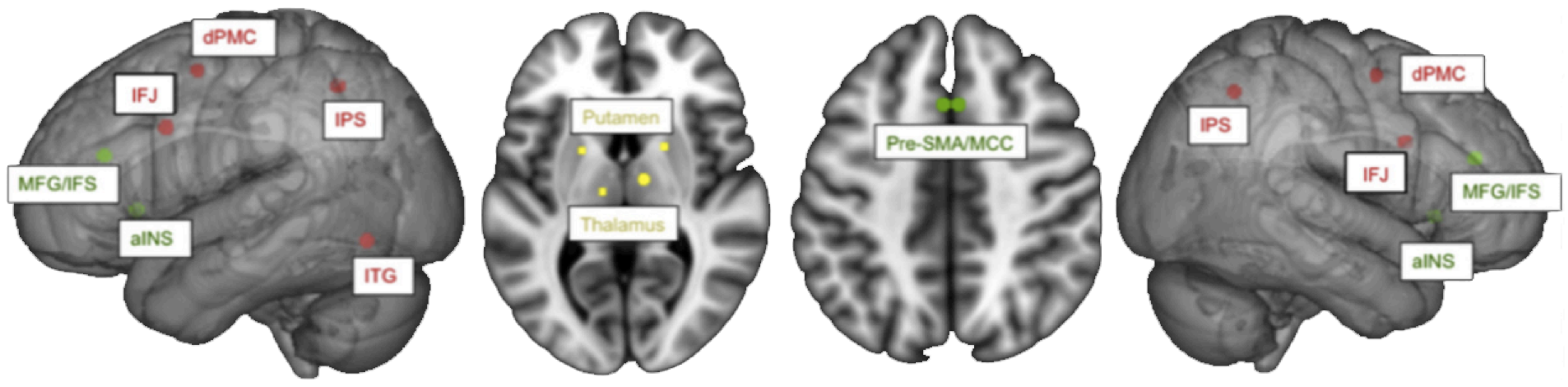


digit span task

Methods



- **Voxel-based morphometry** (VBM) for investigating association of grey matter volume (GMV) and performance on both recall versions of both tasks
- Whole-brain and regional analyses
- Regional analyses used **extended multiple demand network (eMDN)**
  - subsumes regions functionally connected to regions activated across multiple demands
- Covariates of no interest: age and gender
- T1-weighted imaging data of 765 subjects from the „1000BRAINS“ study was analysed
- Age range: 55 to 76 years (mean: 65.9 years, SD: 5,6 years)



Regions of the eMDN, adapted from Camilleri et al., 2018

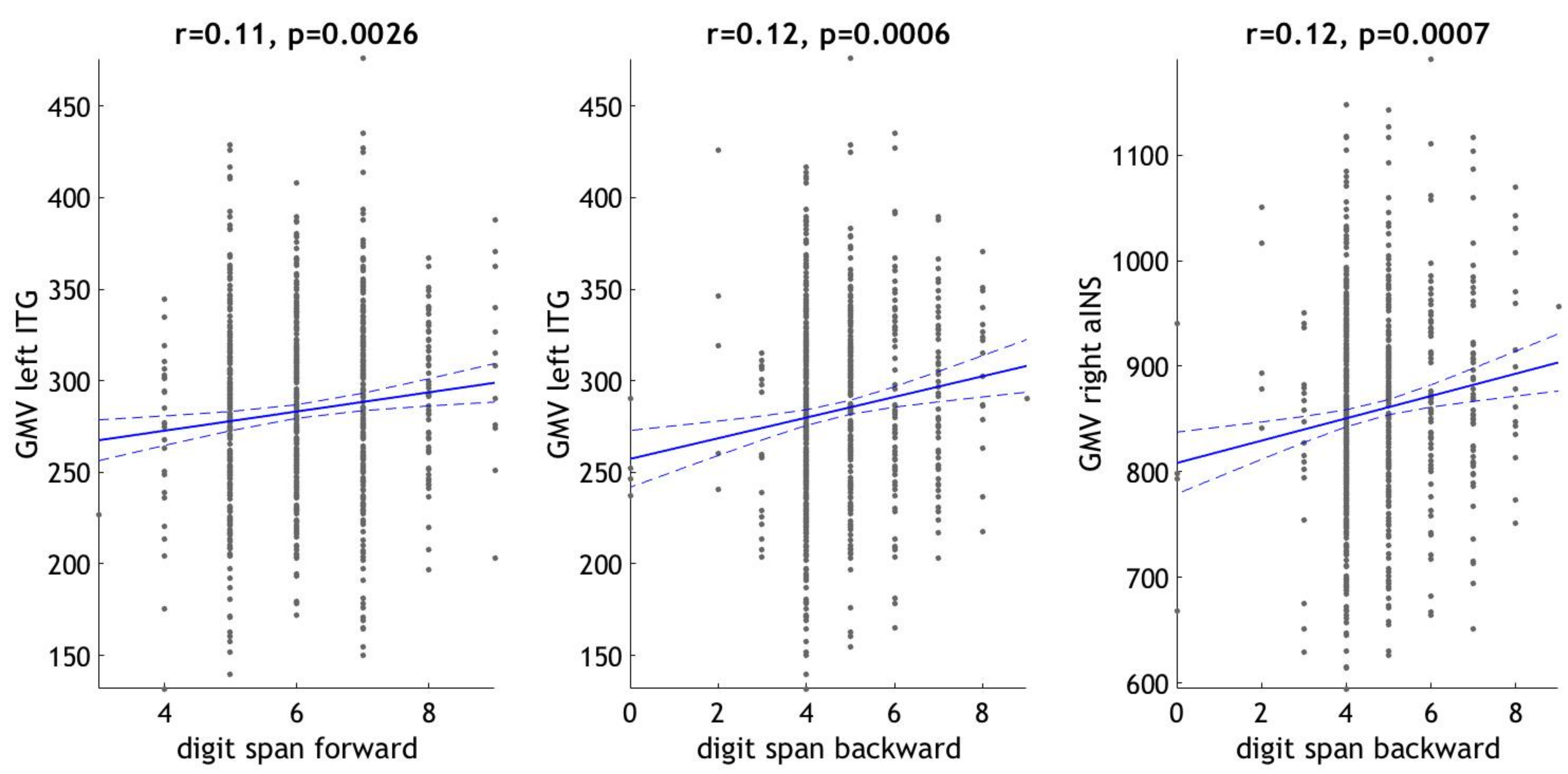
Results

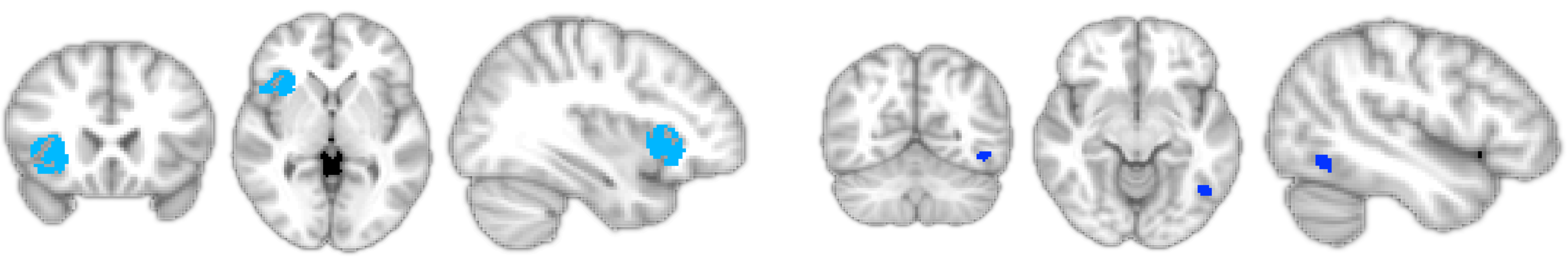
1 Whole brain results.

- **No significant correlations** between GMV and performance in either recall version of either test

2 Regional results.

- CORSI block tapping task
  - **No significant correlations** between GMV in either region of the eMDN with performance on forward or backward recall
- Digit span task
  - Forward recall was positively correlated with GMV in the left inferior temporal gyrus (ITG) ($r(764)=0.11$, $p=0.0026$)
  - Backward recall was positively correlated with GMV in the right anterior insula (aINS) ($r(764)=0.12$, $p=0.0007$) and left ITG ($r(764)=0.12$, $p=0.0006$)





Left (light blue): right anterior insula
Right (darker blue): left inferior temporal gyrus

Discussion

- Findings of structural correlates of WM are inconsistent
- Insula involved in executive processes
  - Significant correlation for right aINS only for the backward digit span: **more executive control** involved in backward compared to forward recall
- Left ITG is linked to semantic processes, may play a role in verbal WM
- Significant correlations showed only **small effect sizes**
  - Similar to recent large sample studies using VBM
- Lack of significant results on whole-brain level:
  - **GM might not be relevant neural substrate** when investigating WM performance or differences between the visuospatial and verbal component
  - Other factors might have stronger contribution

References: Baddeley, A. (2012). Working Memory: Theories, Models, and Controversies. In S. T. Fiske, D. L. Schacter, & S. E. Taylor (Eds.), *Annual Review of Psychology, Vol 63* (Vol. 63, pp. 1-29). Palo Alto: Annual Reviews.; Camilleri, J. A., Muller, V. I., Fox, P., Laird, A. R., Hoffstaedter, F., Kalenscher, T., & Eickhoff, S. B. (2018). Definition and characterization of an extended multiple-demand network. *Neuroimage, 165*, 138-147. doi:10.1016/j.neuroimage.2017.10.020; Caspers, S., Moebus, S., Lux, S., Pundt, N., Schutz, H., Muhleisen, T. W., . . . Amunts, K. (2014). Studying variability in human brain aging in a population-based German cohort-rationale and design of 1000 BRAINS. *Frontiers in Aging Neuroscience, 6*, 14. doi:10.3389/fnagi.2014.00149

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