The Effect of Age on Longitudinal Measures of Resting State Functional Connectivity

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Background

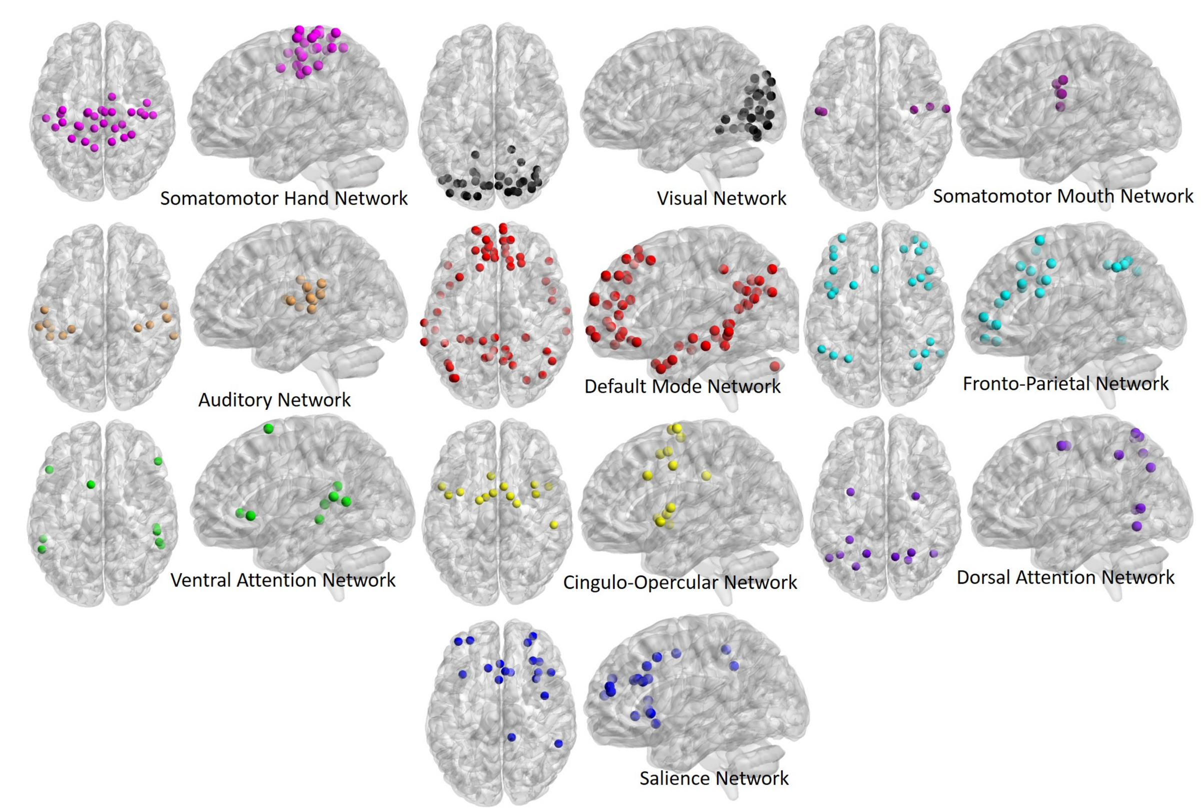
- Recent focus on functional connectivity in aging to explain cognitive aging trajectories
  - During a task - In younger adults, negative correlation between task-relevant (i.e., FP) and task-irrelevant (i.e., DMN) networks; in older adults, less negative correlation between these networks associated with poorer performance on task
- Cross-sectional analyses show effect of age on many metrics of resting state functional connectivity, but limited relationship between these metrics and cognitive performance
- **Research Questions:**
  - Do longitudinal analyses show changes in connectivity metrics over time that are consistent with cross-sectional age effects?
  - Are these changes in resting state connectivity related to change in cognitive performance over time?

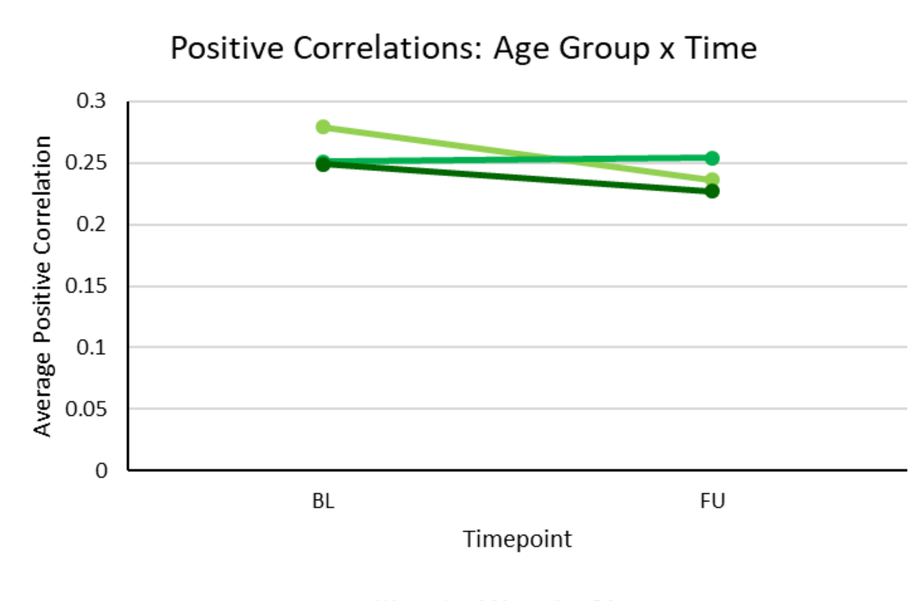
Methods

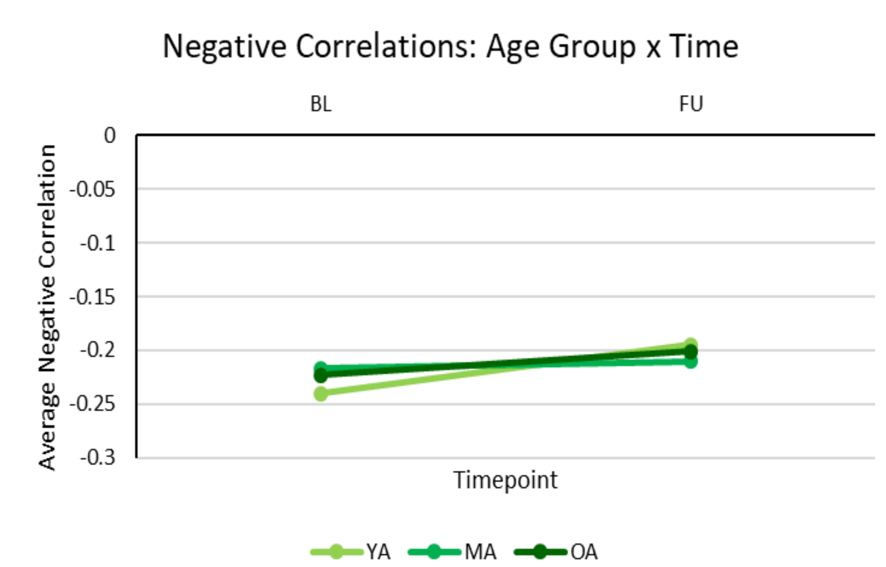
- **Participants** (RANN & CR Studies; Stern et al., 2014)
  - N=127 healthy adults (YA: age 20-39, n=39; MA: age 40-60, n=31; OA: age 61-80, n=57)
  - All participants completed baseline and 5-year follow-up imaging and neuropsychological assessments
- **fMRI Data Processing**
  - 5- or 9.5-minute resting state protocol
  - Extracted preprocessed, filtered, scrubbed, and motion-corrected timeseries data from Power et al. (2011) ROIs
  - Generated correlation matrices among all 264 ROIs for each participant
- **Functional Connectivity Metrics**
  - Separate MANCOVA analyses on average positive/negative correlations within and between 10 brain networks to test whether they were affected by age and time (covariate: scrubbing percentage)
  - MANCOVA analyses on system segregation (computed on only positive correlations: average within-network correlation – average between-network correlation/average within-network correlation) to test whether it is affected by age and time (covariate: scrubbing percentage)
  - Correlations between change in connectivity metrics and change in neuropsychological task performance

Results

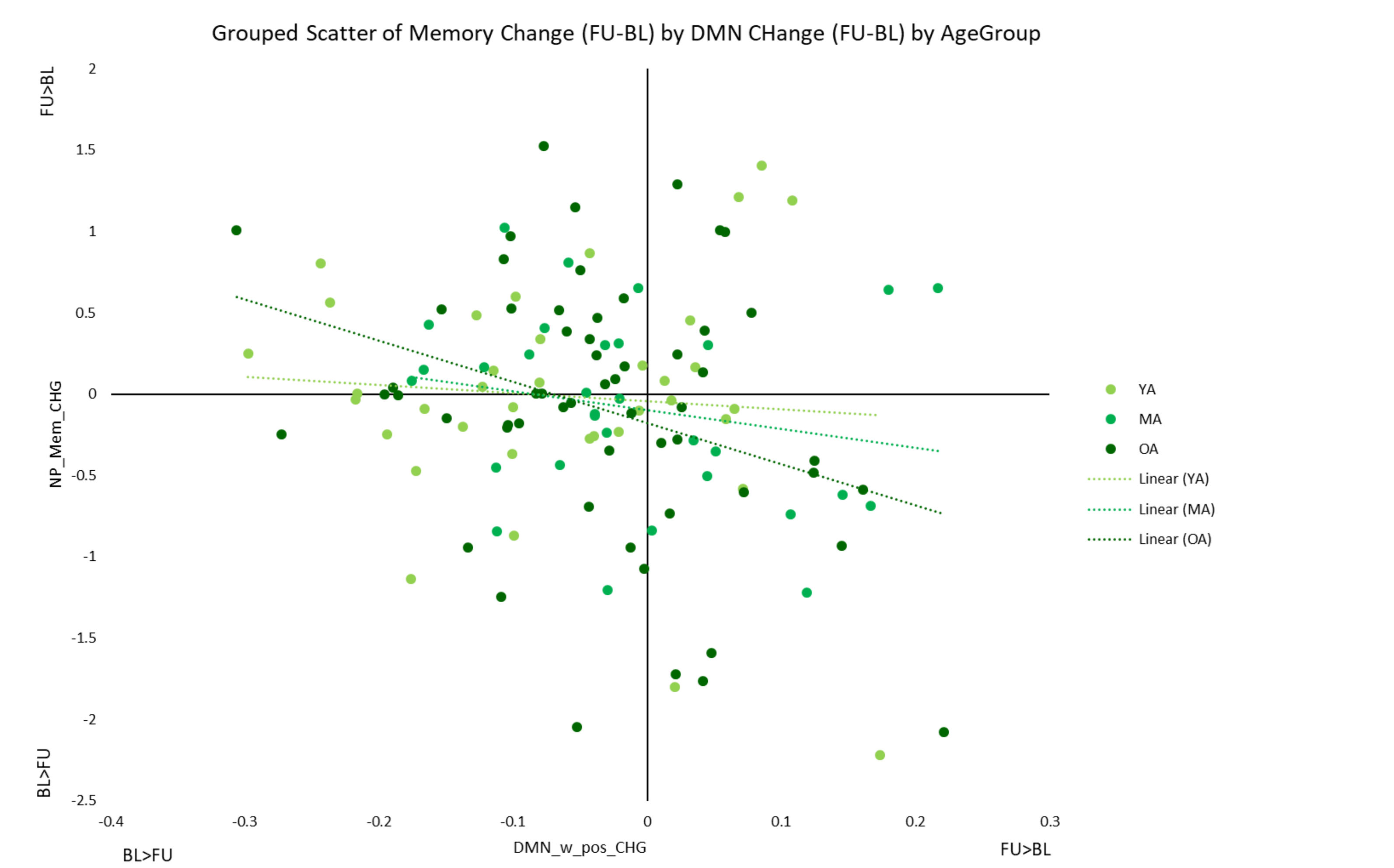
- **Positive Correlations:** Significant interaction between time and age group ($F_{2,119}=4.400$, p=0.014); main effect of time ($F_{1,119}=8.243$, p=0.005)
  - Overall, weakening positive correlations between baseline and follow-up; only significant for YAs and marginally significant for OAs
- **Negative Correlations:** Marginal interaction between time and age group ($F_{2,123}=3.010$, p=0.053); main effect of time ($F_{1,123}=9.793$, p=0.002)
  - Overall, weakening negative correlations between baseline and follow-up; marginally significant for YAs

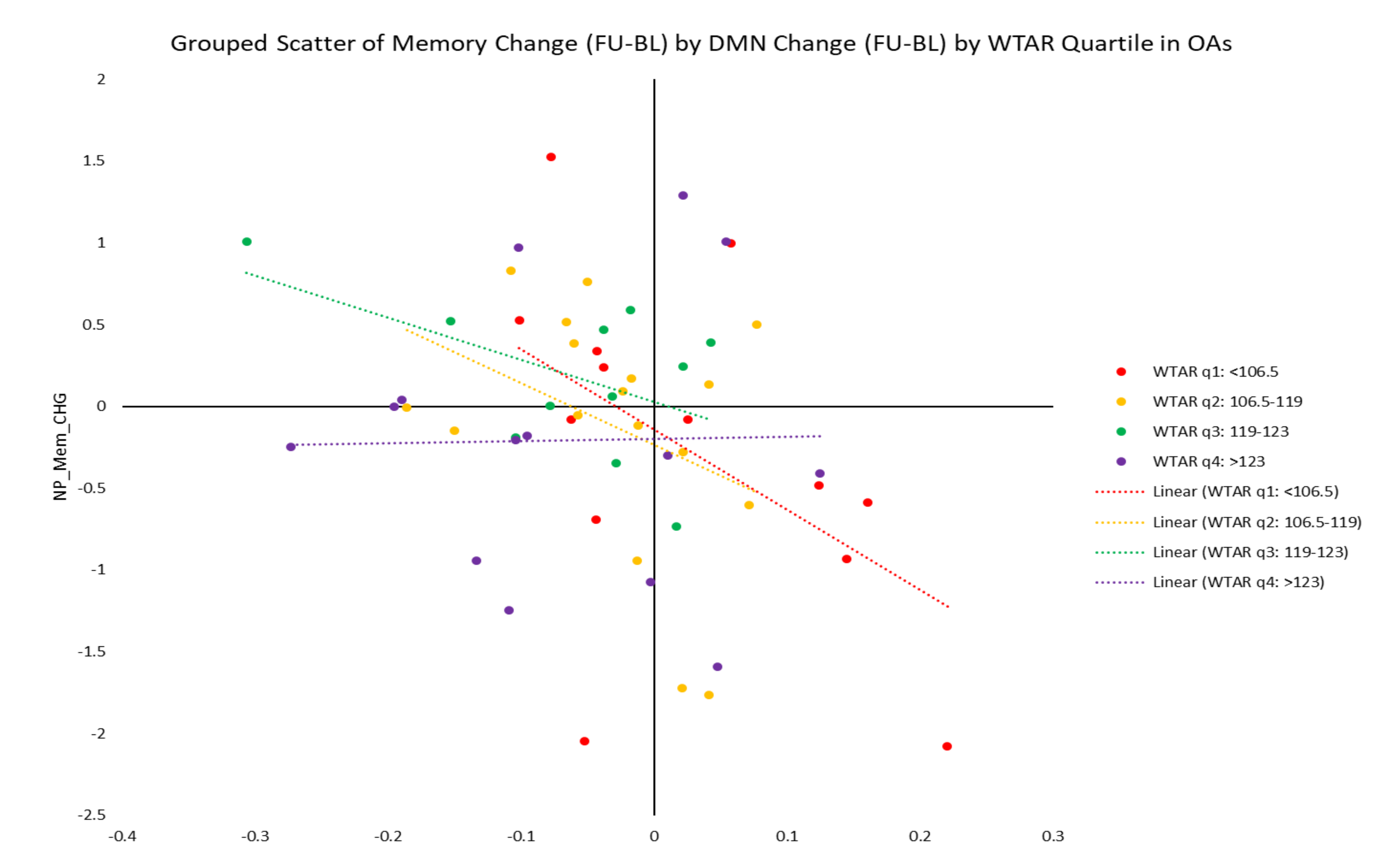






- **System Segregation:** No effect of age group or time on system segregation across somatomotor or association networks
- **Correlations:** Significant relationship between change in average within-DMN positive correlation and change in memory task performance (r=-0.217, p=0.015)
  - Also related to baseline WTAR (r=-0.209, p=0.018)/NART (r=-0.222, p=0.013) IQ
  - In regression analysis, marginal interaction between DMN change and Age (standardized beta=-4.662, p=0.059), and among DMN change, Age, and WTAR IQ (standardized beta=4.148, p=0.087)





Conclusions

- Positive and negative correlations show a general weakening over a 5-year period, with this effect being most pronounced in YAs
- Change in within-DMN connectivity seems to be associated with baseline metrics of IQ, and predicts change in memory performance over 5 years (which may be partially mediated by IQ in OAs)
- Generally, longitudinal weakening correlations with age seem to be consistent with cross-sectional studies showing weakening positive correlations in the context of aging
- Future analyses should explore additional connectivity metrics and delve deeper into relationships between change in connectivity and change in cognitive outcomes

References

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Acknowledgments: NIA RF1AG038465 (RANN) & R01AG026158 (CR)