Poster #T360

Reconfiguration of functional networks during cognitive control across the adult lifespan

Jenny Rieck[1] **Giulia Baracchini**[1] **Daniel Nichol**[1] **Hervé Abdi**[2] **Cheryl Grady**[1]

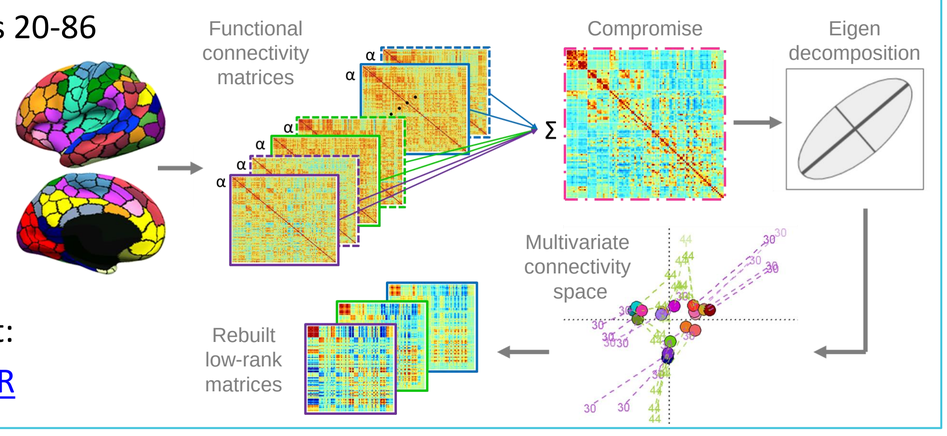
[1] Rotman Research Institute, Baycrest Centre, Toronto ON [2] University of Texas Dallas, Dallas TX

Background

- Cognitive control comprises three core factors: inhibition, shifting, and working memory.[1]
- The degree to which these factors represent common vs. distinct domains of cognition is unclear[2], particularly in healthy aging.[3]
- Our goal was to explore functional connectivity during cognitive control to better understand neural mechanisms for each domain and how they differ across the adult lifespan.

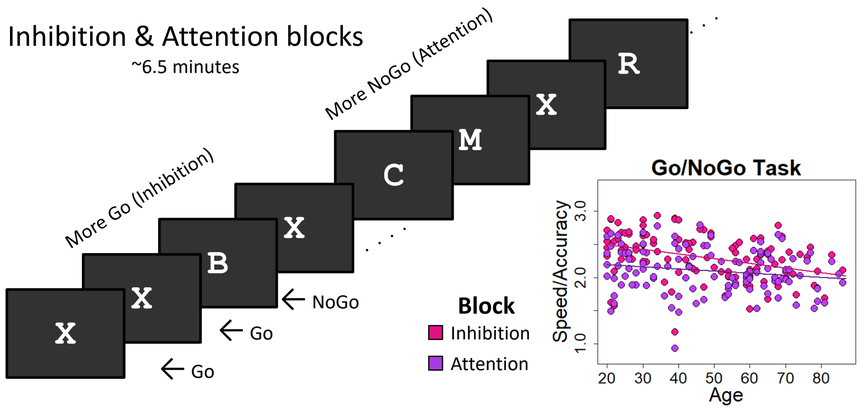
Methods

- *N* = 111 cognitively normal adults, ages 20-86
- Functional connectivity computed during 3 fMRI tasks with 100 node 17 network parcellation[4,5]
- Connectivity matrices analyzed with multi-table PCA technique: **covSTATIS**[6]
- R package & Shiny App in development: https://github.com/jennyrieck/C-MARINeR

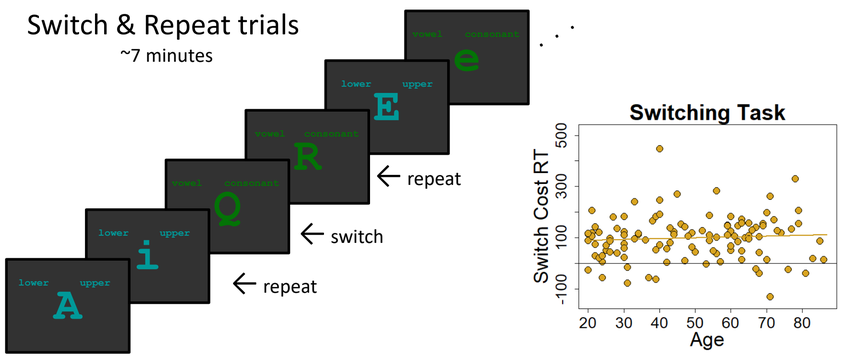


fMRI Tasks

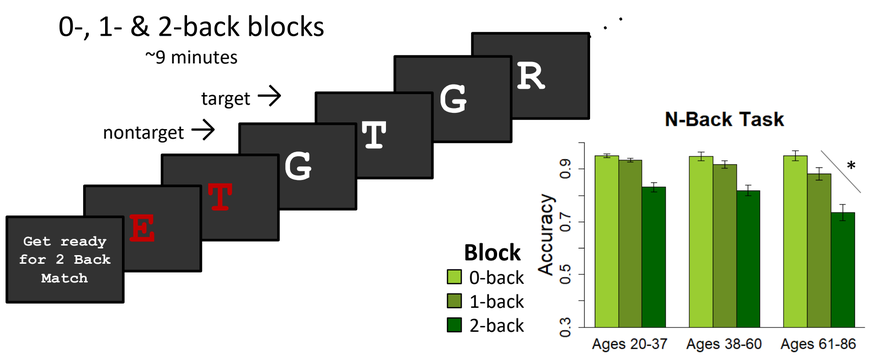
Inhibition: Go/NoGo



Shifting: Letter Judgment



Working Memory: N-Back



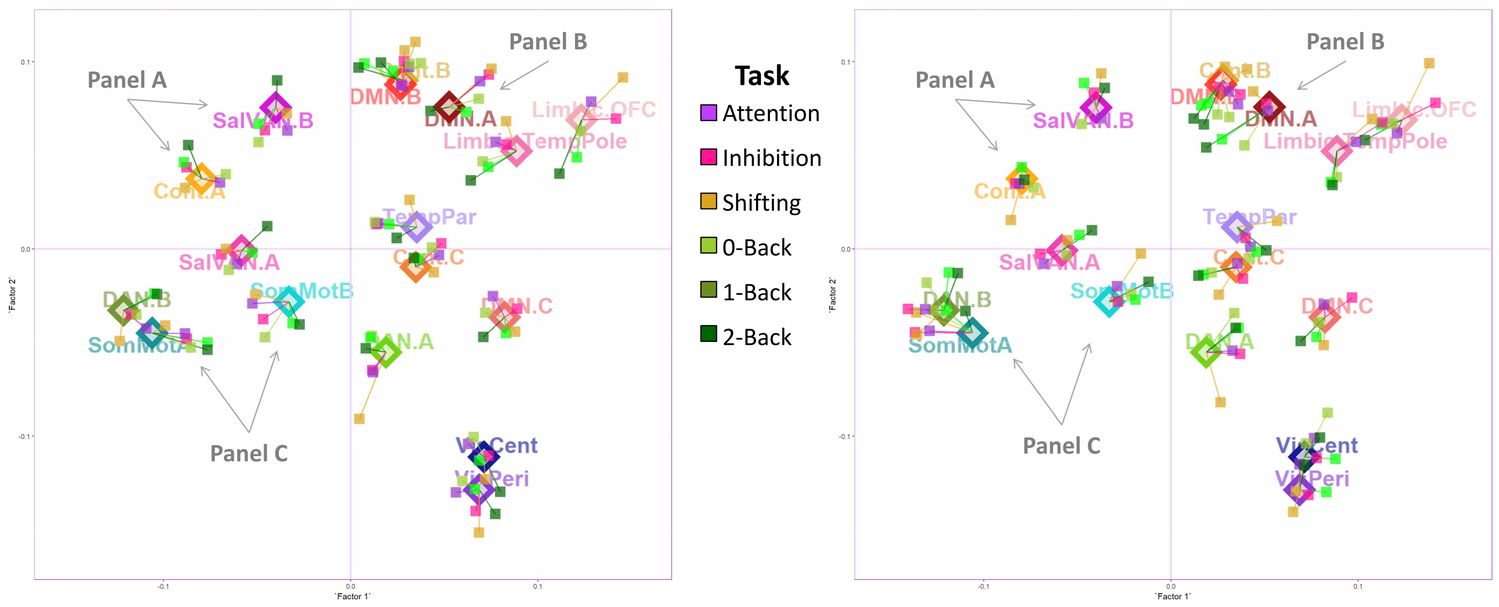
covSTATIS Results

Younger Adults (20-37 years)

Network Configuration by Task

Older Adults (61-86 years)

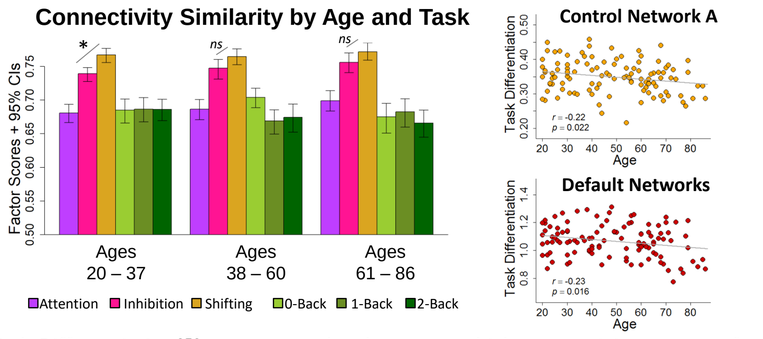
Network Configuration by Task



The multivariate connectivity subspaces for younger and older adults have been plotted to illustrate age differences in connectivity profiles. Network averages are represented by diamonds. Squares projecting from the diamonds represent the task-specific connectivity profile for that network and age group. Points closer together represent shared patterns of connectivity. Several age differences in connectivity patterns are highlighted in the panels below.

A. Age-Related Dedifferentiation

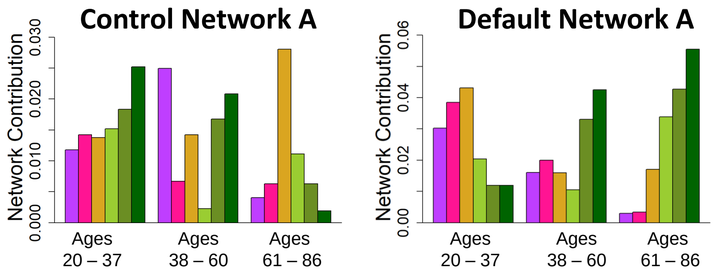
Patterns of connectivity associated with inhibition and shifting become more similar in older age



Task Differentiation[7] represents the degree to which connectivity patterns for each network are distinct for each domain (i.e., distance of each domain to its center). Significant age effects found for Control A, Default, & Ventral Attention A.

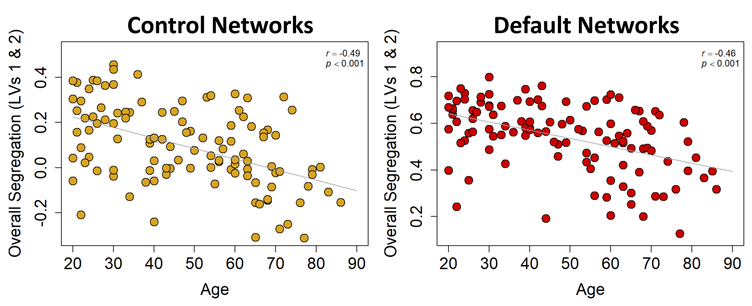
B. Task Specific Age Differences in Network Contribution

Older adults show a shift from Control to Default networks during working memory that scales with load



Select networks have been plotted to show age group differences in the contribution of each network to different domains of cognitive control.

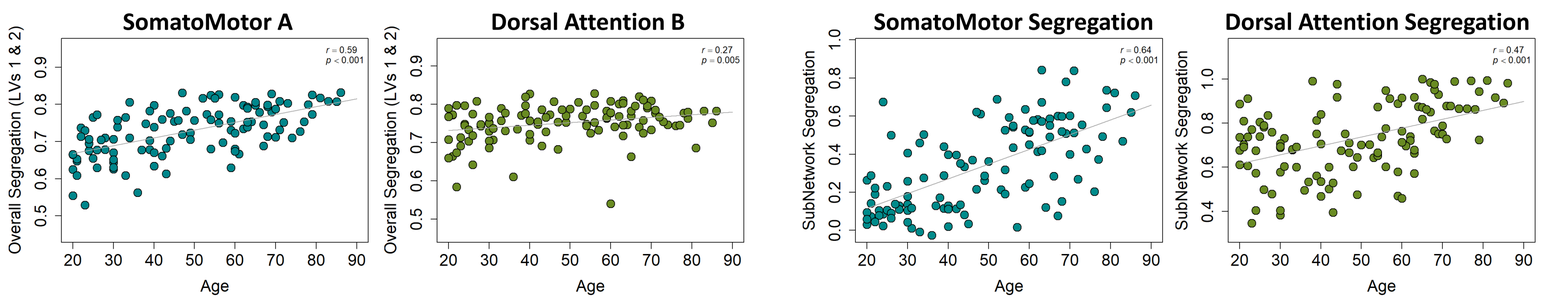
C. Age-Related Network Reconfiguration



With increasing age, Control and Default networks are more integrated with other brain networks

Overall segregation (left, below left) is calculated as the difference of within and between network connectivity[8] across all networks for low-rank connectivity matrices rebuilt from components 1 & 2 of the multivariate space.

Older adults show greater segregation of and disconnection within Dorsal Attention and SomatoMotor networks



Subnetwork segregation (above right) is calculated as the difference of within and between network connectivity[8] for only subnetworks within a larger network for low-rank matrices rebuilt from components 1 & 2 of the multivariate space.

Discussion

- Control and Default networks both show age-related dedifferentiation (**A**) suggesting cognitive control domains, particularly inhibition and shifting, are less distinct in older age, perhaps due to reduced network segregation (**C**).
- Dorsal attention and motor networks show increased segregation in older age (**C**), providing evidence for multiple forms of network configuration during task in healthy aging, which differs from previous findings at rest.[7-9]
- There are task specific differences in which networks are more important across the lifespan. Middle-aged and older age adults rely more on default and less on control connectivity during working memory (**B**).
- Taken together our results suggest age differences in network configuration and engagement manifest differently depending on task.

[1] Miyake et al. (2000) *Cog Pysch*
[2] Miyake & Friedman (2012) *Curr Dir Psych Sci*
[3] Salthouse et al. (2003) *JEP General*
[4] Schaefer et al. (2017) *Cereb Cortex*
[5] Whitfield-Gabrieli & Nieto-Castanan (2012) *Brain Conn*
[6] Abdi et al. (2012) *NeuroImage*
[7] Grady (2012) *Nat Neuro Rev*
[8] Chan et al. (2014) *PNAS*
[9] Grady et al. (2016) *Neurobio Aging*

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jrieck@research.baycrest.org