Poorer white matter microstructure predicts slower and more variable reaction time performance

Ethan M. McCormick

Radboudumc

DONDERS INSTITUTE

ethan.mccormick@radboudumc.nl

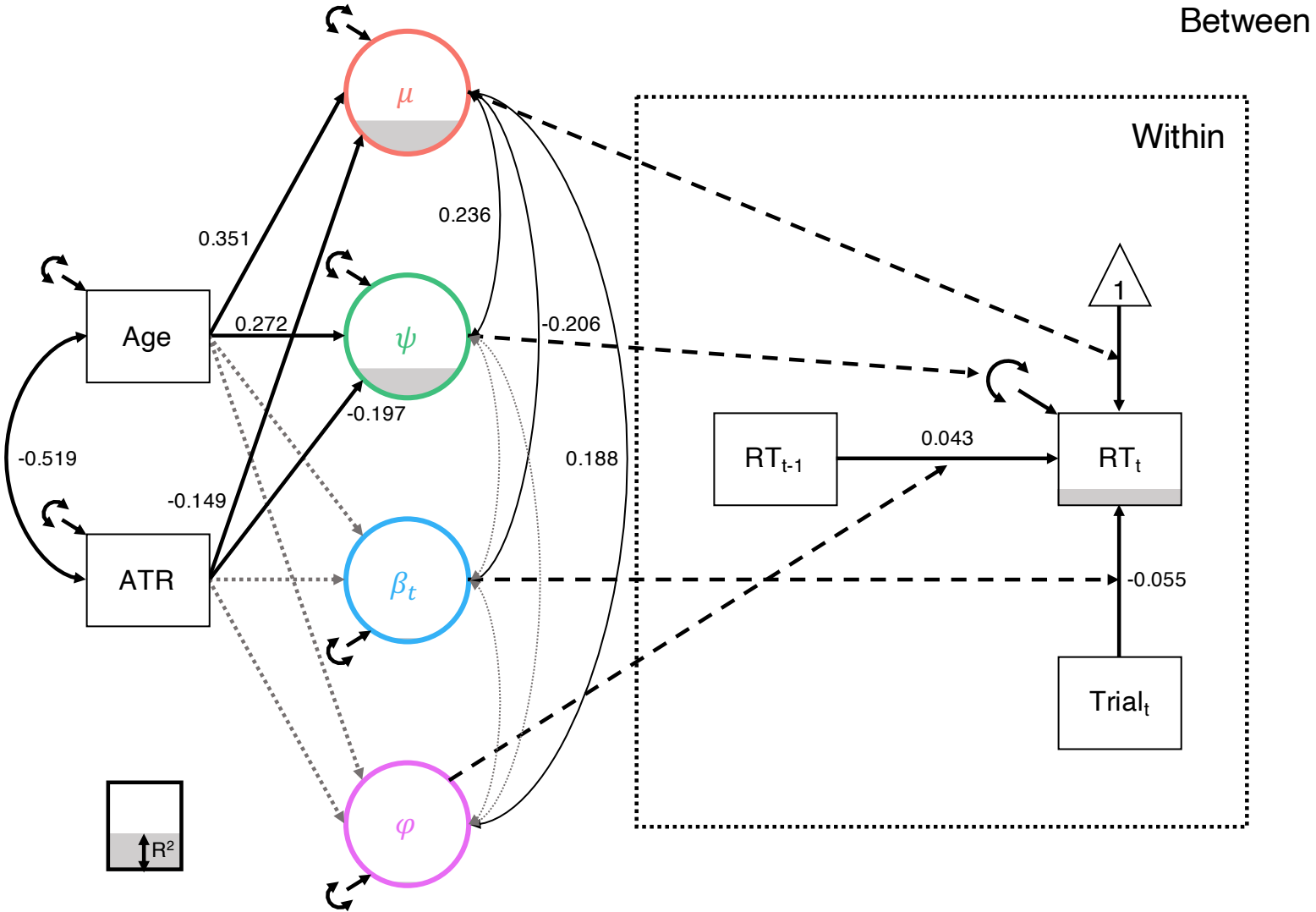
@McCormickNeuro

https://mccormickneuro.github.io/

Preprint link ➡️

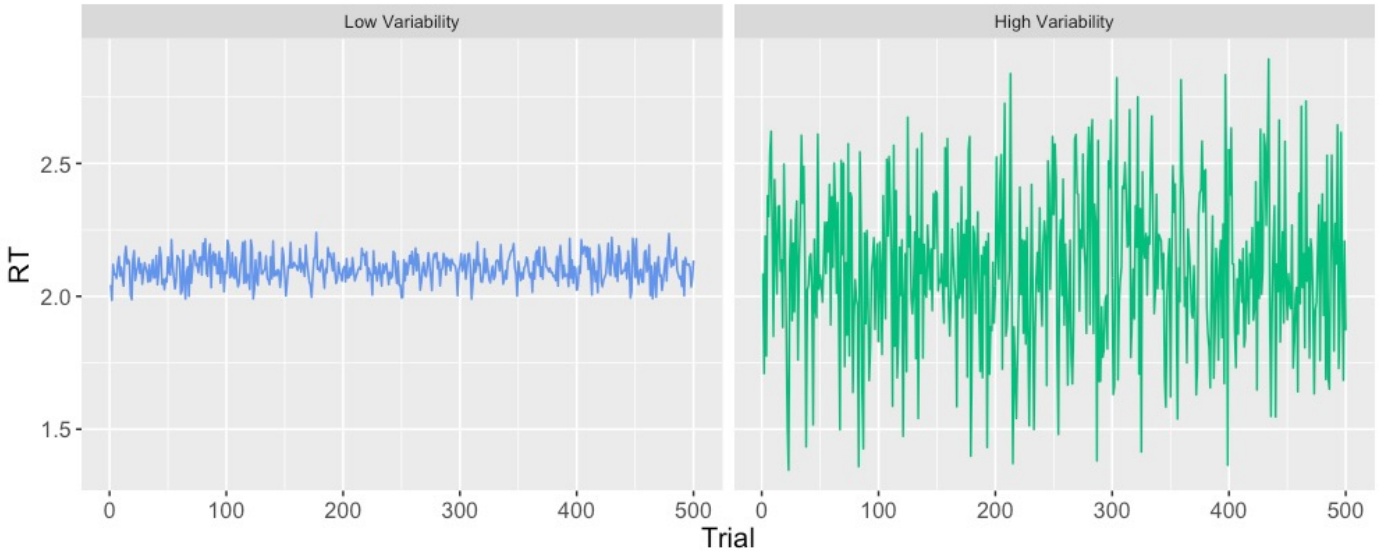
Take Home Message

While prior research has focused almost exclusively on declines in mean reaction time performance during aging, we also modeled increases in variability associated with both age and poorer white matter microstructure (ATR) using a dynamic structural equation model.



Introduction

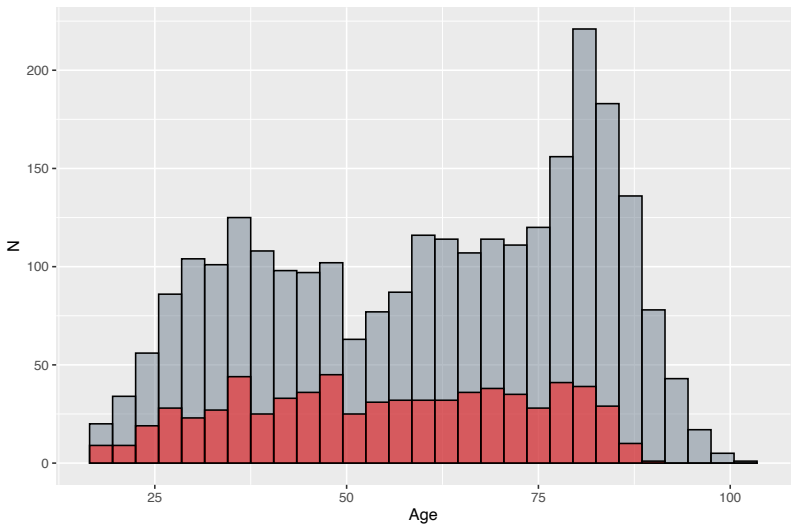
- Vast majority of research focuses on mean performance but this hides variability differences[1]



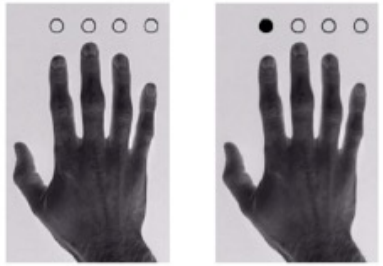
- Individual differences in variability might have unique causal pathways
  - Hypothesize that reduced white matter microstructure will increase variability due to a reduced signal-to-noise ratio in signal conduction (neural noise hypothesis)[2]

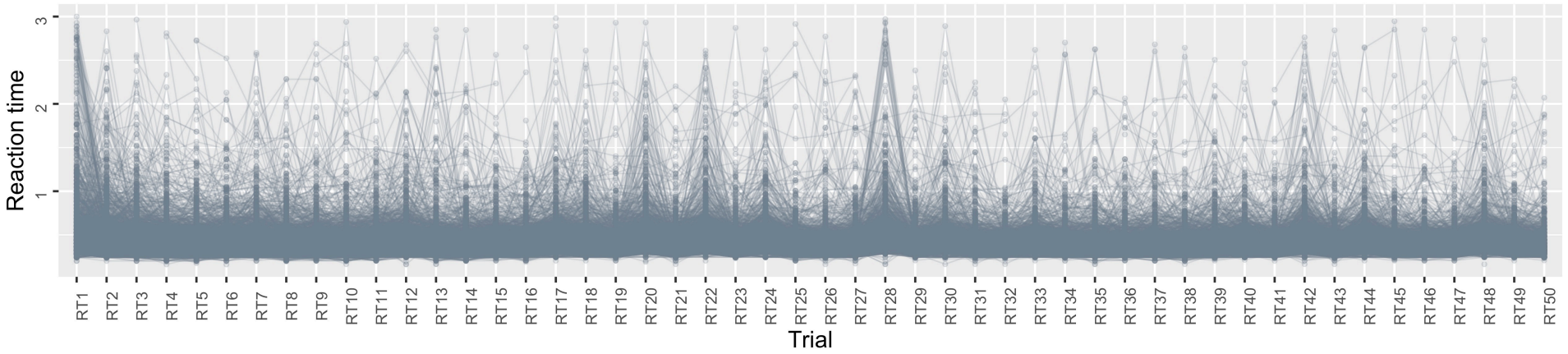
Sample

- Cambridge Centre for Ageing and Neuroscience (Cam-CAN) dataset[3,4]
  - N=2681 (708 neuroimaging; red); ages 18-102



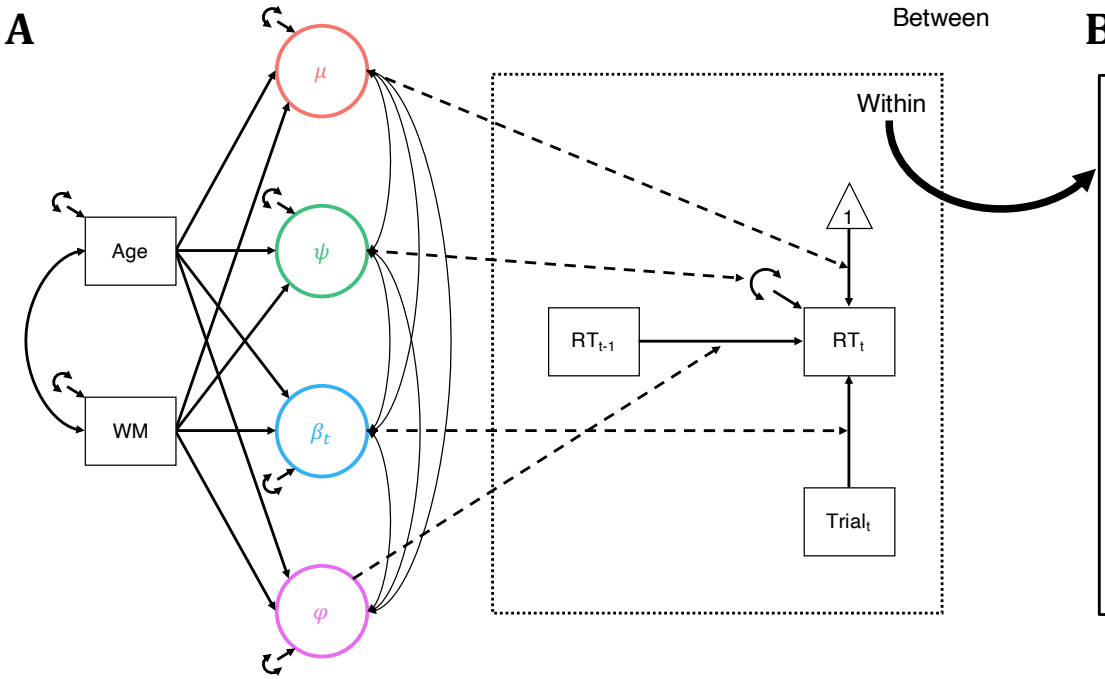
- Simple RT task
  - 50 trials

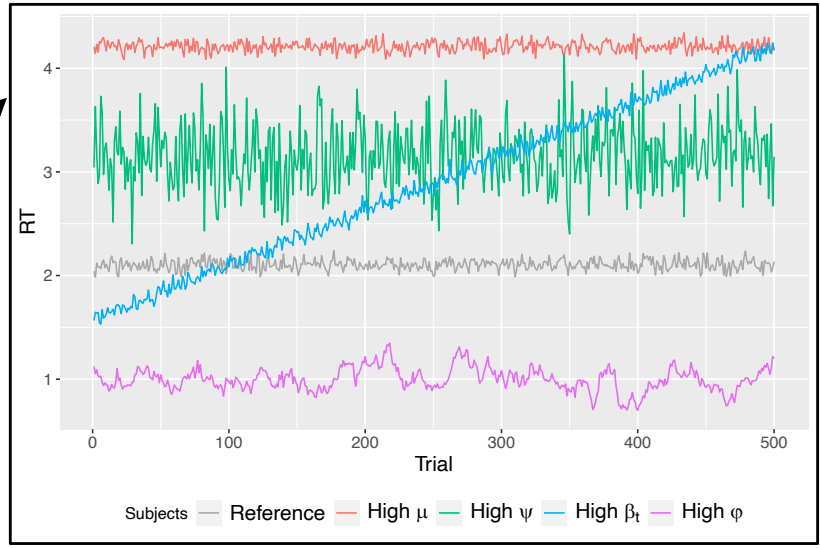




Methods

- Modeling variability is challenging and requires advanced methods → Dynamic Structural Equation Model (DSEM)[5]
  - Allows us to model individual differences in mean RT (μ), variability (ψ), trends within-session (β_t), and autoregressive effects (φ)

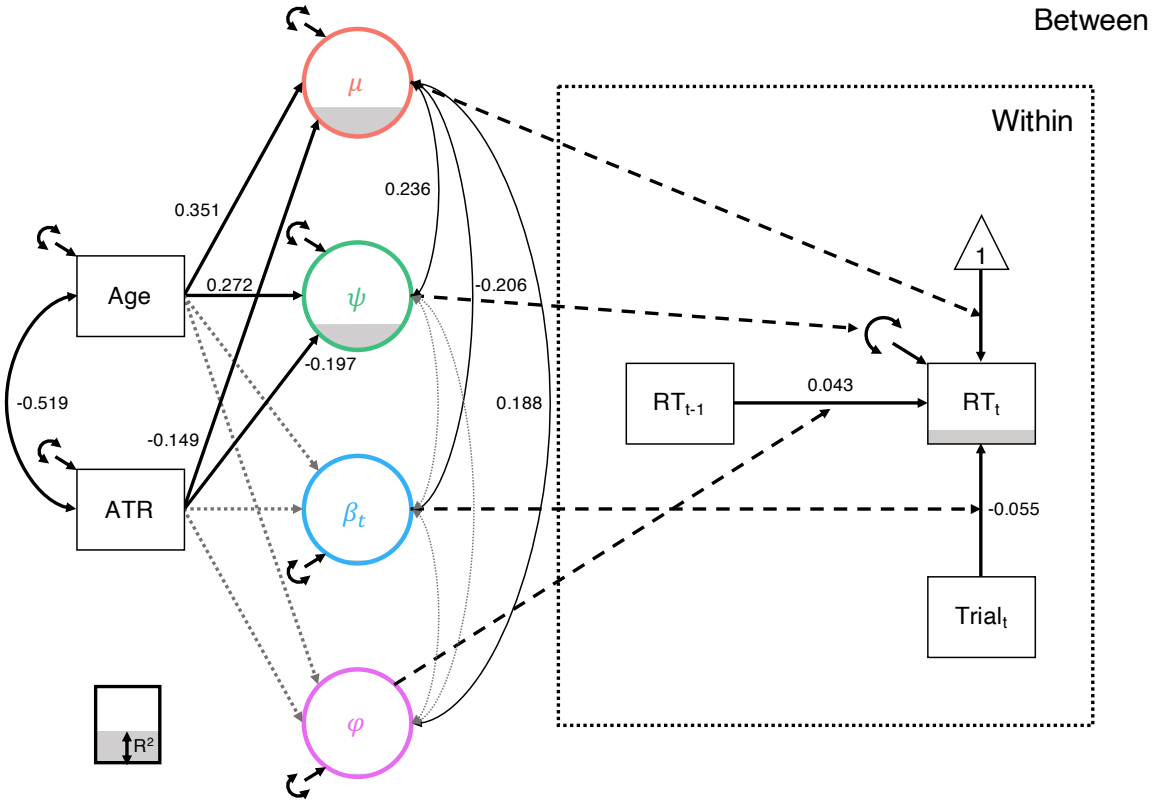




Results

- Using the DSEM, we were able to model individual differences in mean RT and RT variability

- Increased age and decreased WM predicted poorer performance (i.e., slower and more variable)



Discussion

- Demonstrated exciting extension of cognitive models of change across development/aging to include variability
  - DSEMs are a powerful tool for simultaneously modeling many components of behavior
- Tested the role of WM in implementing fast, consistent behavioral performance
  - Effects held when controlling for age
  - Reductions in 'neural noise'
- Framework can be extended to test specific causes and outcomes associated with mean performance and variability

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