Adolescent Cognitive Development and Connectivity
A Preliminary Network Analysis on Neurocognitive Measures of the ABCD Study

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Introduction

The ABCD Study and The Measurement Model of Neurocognitive Measures

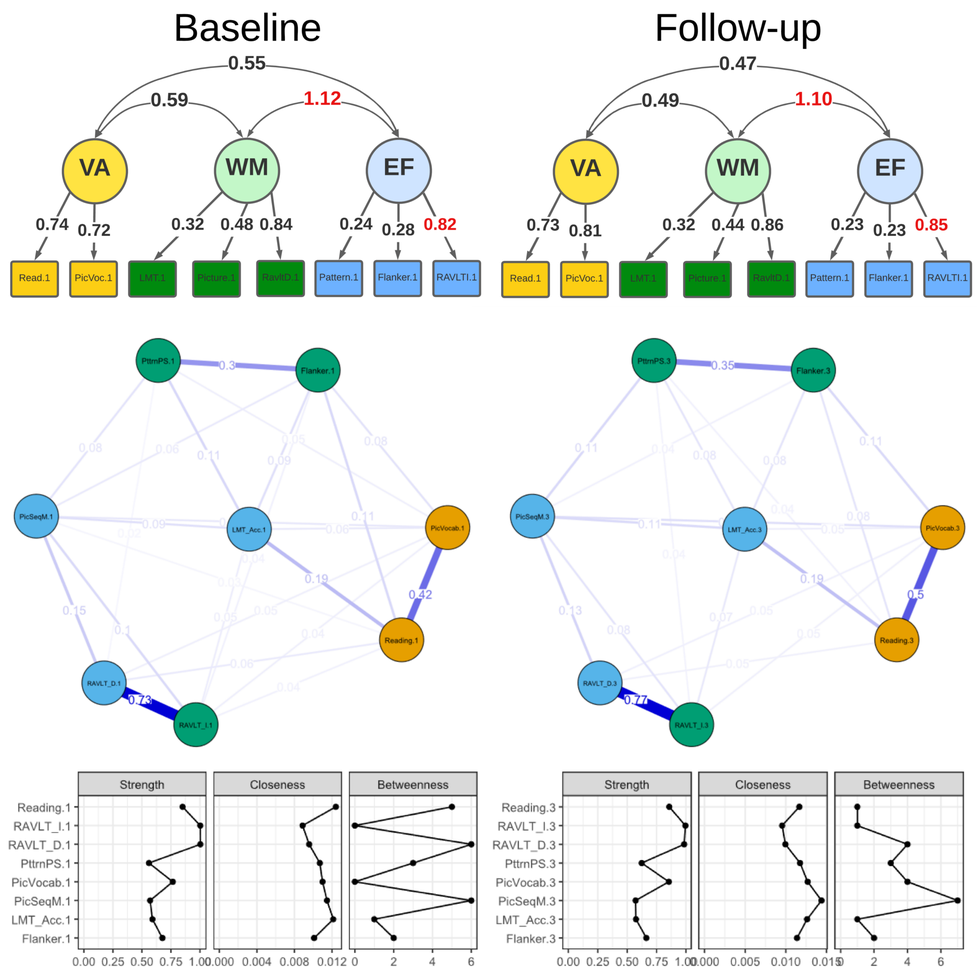
- The Adolescent Brain Cognitive Development (ABCD) Study is an ongoing, large-scale longitudinal project of over 11,000 U.S. children, featuring multiple waves of neurocognitive assessments including executive function, working memory, language, expressive ability, and related domains.
- Moore and Conway (2023) demonstrated that a correlated three-factor CFA of eight ABCD baseline neurocognitive measures offers superior construct validity compared to earlier PCA-based components (Thompson et al., 2019).

The Present Study

- The present study builds on Moore & Conway (2023) by re-examining both the baseline (9–10 years) and three-year follow-up (12–13 years) correlation matrices reported by Anokhin et al. (2022).
- We applied both confirmatory latent-factor models and psychometric network models to directly compare the cognitive architecture exhibited at each wave.
- Process Overlap Theory (POT) proposes that intercorrelations among cognitive tasks arise from overlapping contributions of domain-general executive processes and domain-specific skills.
- From a developmental perspective, we predict that as executive processes mature, the associations among domain-general measures will weaken, while the those with domain-specific measures will strengthen over time.

We apply confirmatory latent factor models and psychometric network models to both baseline and 3-year follow-up data of ABCD neurocognition tasks to estimate and compare the psychometric structures of cognitive abilities at different times.

Key Results



Methods & Results

Data & Statistical Procedures

ABCD Neurocognitive Tasks

8 Neurocognitive measures available in both waves

Correlation Matrices from Anokhin et al (2022)

N estimated from the harmonic mean of reported sample sizes

Psychometric Modeling

- Regular Gaussian graphical network models and latent networks on both matrices (Baseline and Followup)

CFA Model: 3-factor, correlated, align with Moore & Conway (2023)

Network Model: Non-directional, pruned based on edge significance and BIC

Summary of Results

- The most pronounced change across the networks was a stronger network edge between the two verbal ability tasks at 3-year follow-up.
- Picture Sequence Memory showed increased closeness at Year 3, while betweenness indices rose for Picture Vocabulary and RAVLT Immediate.
- All other task-to-task associations and centrality metrics remained largely unchanged across waves.
- The minimal shifts may reflect the relatively short interval between baseline and follow-up and the absence of additional waves or cross-wave connectivity data.

Conclusion & Future Directions

- **The latent factor models were partially consistent with the findings from Moore & Conway (2023), acknowledging the deviation of RAVLT immediate recall as an “EF” measure.**
- **The strengthened verbal edge in the network model supports that crystallized (verbal) abilities consolidate their roles in cognition over time, and slight centrality changes for memory and vocabulary tasks hints emerging roles for the specific abilities.**
- **According to both types of models, early adolescence appears to involve subtle reconfiguration of cognitive interrelations rather than wholesale restructuring.**

Future Direction & Resources

Extended longitudinal data and cross-wave analyses are needed.

Dynamic network modeling & latent change-scores modeling for a next step.