Individual Differences in Mixing Costs Relate to General Executive Function

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Background

❖ **Current accounts of switching tasks focus on Switch Costs**

- **Processes:** Transient cognitive control to reconfigure task set
- **Measurement:** Local switch cost (Mixed-Block Switch Trial RT – Repeat Trial RT)

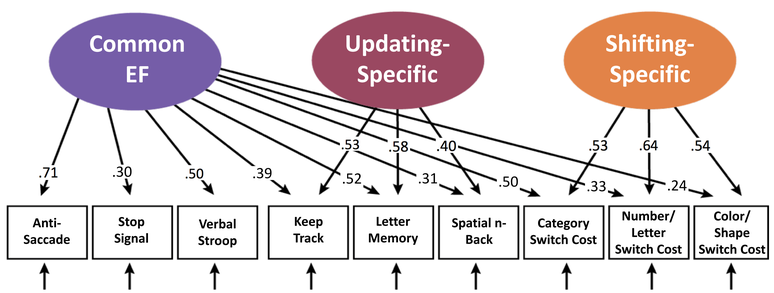
❖ **Mixing Costs may provide insight into distinct cognitive processes**

- **Processes:** Sustained cognitive control to maintain task goals and overcome interference from competing task sets
- **Measurement:** Mixing cost (Mixed-Block Repeat Trial RT – Pure-Block Trial RT)

Study Questions

1. **Do mixing costs arise from a common set of cognitive abilities?**
   - Hyp 1a: Mixing costs load on a single "Mixing" latent factor
   - Hyp 1b: "Mixing" factor will remain after accounting for Speed
2. **Do the cognitive processes underlying Mixing tap executive function (EF) constructs from the Unity and Diversity model?**
   - Hyp 2a: Mixing will correlate with Common EF; not Shifting-Specific or Updating-Specific
   - Hyp 2b: Correlation with Common EF will remain when accounting for Speed

Unity and Diversity Model of Executive Functions



Common EF factor predicts performance on all nine tasks, and two orthogonal factors capture variance specific to Updating and Shifting tasks, respectively (Friedman et al., 2016).

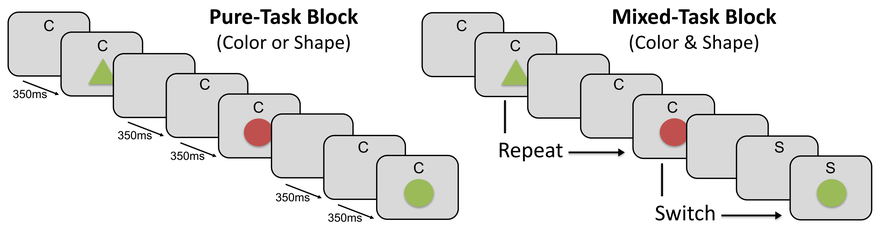
Data and Analysis

- 749 participants from the Colorado Longitudinal Twin Sample (*M* 22.84 years, *SD* 1.29, range 21.11–28.03 years; 400 female, 349 male; from 205 MZ, and 181 DZ pairs)
- Analyses run in Mplus with TYPE = COMPLEX option to account for family structure; all residuals allowed to correlate within shifting tasks

Tasks

Shifting

- Category Switch- Categorize word by size or animacy
- Number Letter- Categorize number or letter (odd/even or consonant/vowel)
- Color Shape- Categorize item by color or shape
- **DVs:** Switch RT, Repeat RT, Pure RT; Mixing Cost, Switch Cost



Inhibition

Anti-Saccade, Stop Signal, Verbal Stroop

Updating

Keep Track, Letter Memory, Spatial n-Back

All RT and Cost Scores reverse coded; see Friedman et al. (2016) for task details and references

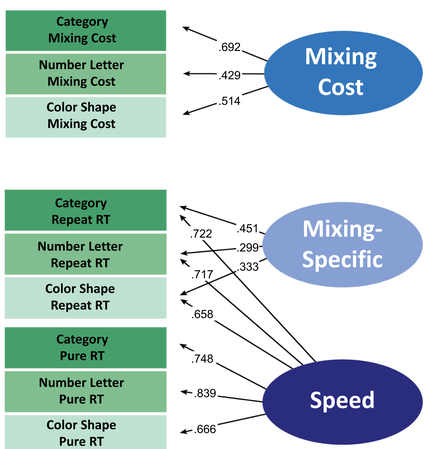
Shared Cognitive Processes Support Mixing

1a Mixing Costs
Load on a single Mixing factor

$\chi^2(0) = 0$, p = 0.00, CFI = 1.00, RMSEA = .000

1b Mixing Cost Components
Load on both a Mixing-Specific and Speed-Specific factor

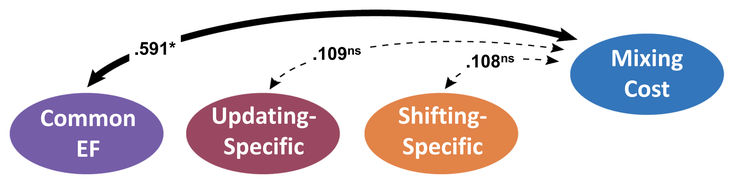
$\chi^2(3) = 1.19$, p = 0.75, CFI = 1.00, RMSEA = .000



References: Friedman, N. P., Miyake, A., Altamirano, L. J., Corley, R. P., Young, S. E., Rhea, S. A., & Hewitt, J. K. (2016). Stability and change in executive function abilities from late adolescence to early adulthood: A longitudinal twin study. *Developmental psychology*, 52(2), 326.

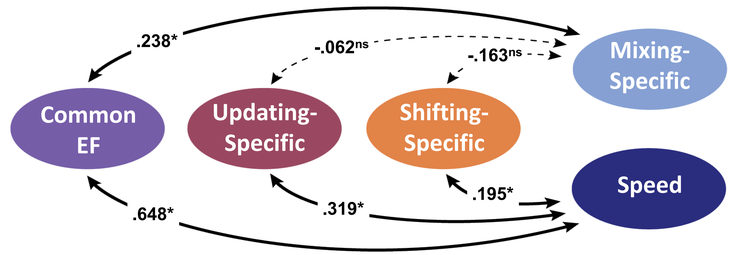
Mixing Taps Common and Distinct EFs

2a Mixing significantly correlated with Common EF



$\chi^2(41) = 79.65$, p = 0.00, CFI = .970, RMSEA = .035

2b Relationship remains when accounting for Speed



$\chi^2(65) = 125.22$, p = 0.00, CFI = .982, RMSEA = .035

Conclusions

❖ **Common cognitive processes support sustained control during mixed block repeat trials**
- Over and above Speed

❖ **These processes tap Common EF, but not Shifting-Specific or Updating-Specific abilities**

❖ **Implications**
- Mixing and Shifting Costs tap both shared and unique EF processes
  - Both tap Common EF abilities
  - **Mixing-Specific and Shifting-Specific processes are distinct**

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