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The Texas Center for Learning Disabilities (TCLD) investigates the classification, early intervention, and remediation of learning disabilities.

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A Structural Framework for Executive Functions in Children

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What is Executive Function?

- EF: a many splendored thing
- Conceptual
  - Linkage to Brain (EF "proper"; Neuropsychology)
  - Self-Regulation Processes (Developmental, Clinical, Educational)
  - Limited Capacity/WM (Cognitive)
- Operational
  - Listing: Planning, Inhibition, Shifting, Fluency, WM
  - Terminology: Integration/Control; Goal-Direction

Models/Theories Implicating EF

- Anderson (2004)
- Stuss et al. (1986; 2011)
- Shallice (1982)
- Baddeley and Central Executive (1976; 2014)
- Cowan/Engle and controlled attention (2001)
- Miyake et al. (2000, 2011)
- Barkley (1990; 2014)
- Roberts & Pennington (1996)

EF Measurement: Parameters

- Age appropriateness/specificity
- Complexity – the elemental v. molar continuum
- The "domain knowledge" it presumes
- Input and output response requirements
- Level of abstractness
- Psychometric properties (reliability/validity)
- Overlap with other EF measures
- The *type* of EF it assess

EF: My Summary

- *EF: domain general control process important for managing goal-directed behavior*
- EF is a process, not a thing (an it or a they)
- We have EF to (a) solve problems; (b) do things requiring effort; (c) act appropriately
  - The goal is critical – attaining a goal is the "result" of EF
- EF is domain general, but tasks/goals will pull differentially for/from various modalities.

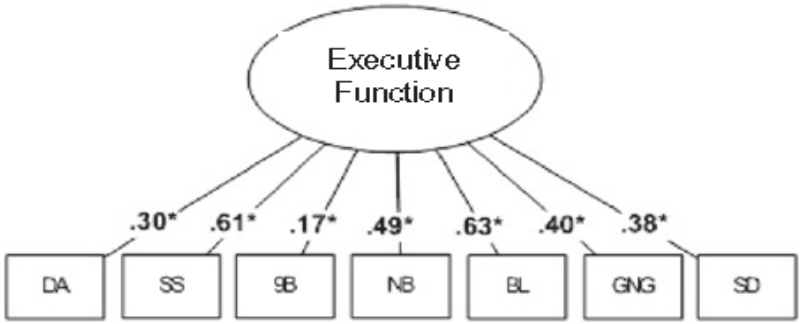
A Framework For EF

- A project of the Texas Center for Learning Disabilities

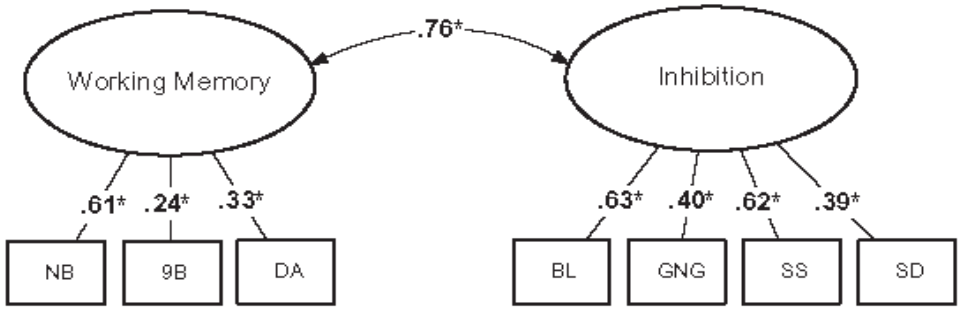
- Elucidate Structure
- Evaluate Developmental Complexity
- Contextualize With More Basic Processes
- Evaluate Predictive Power and Utility (for Reading Comprehension)

- Experimentally Manipulate
  - Small Scale (e.g., Cirino et al., 2016)
  - Large Scale

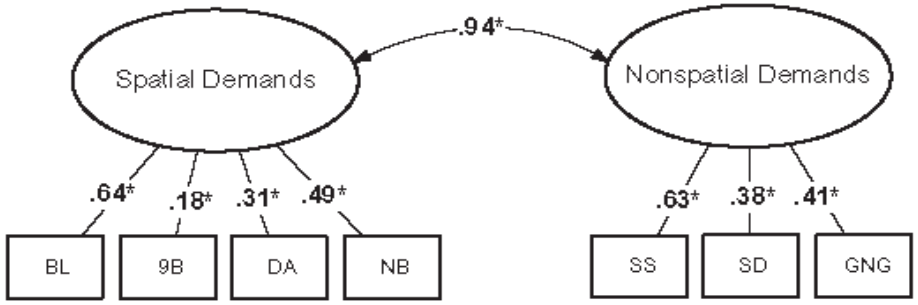
Structure of EF: Preschool



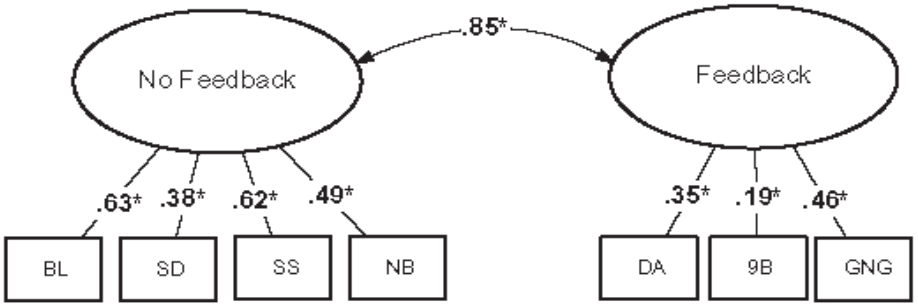
Model 1: Unitary Executive Function



Model 2: Working Memory and Inhibition



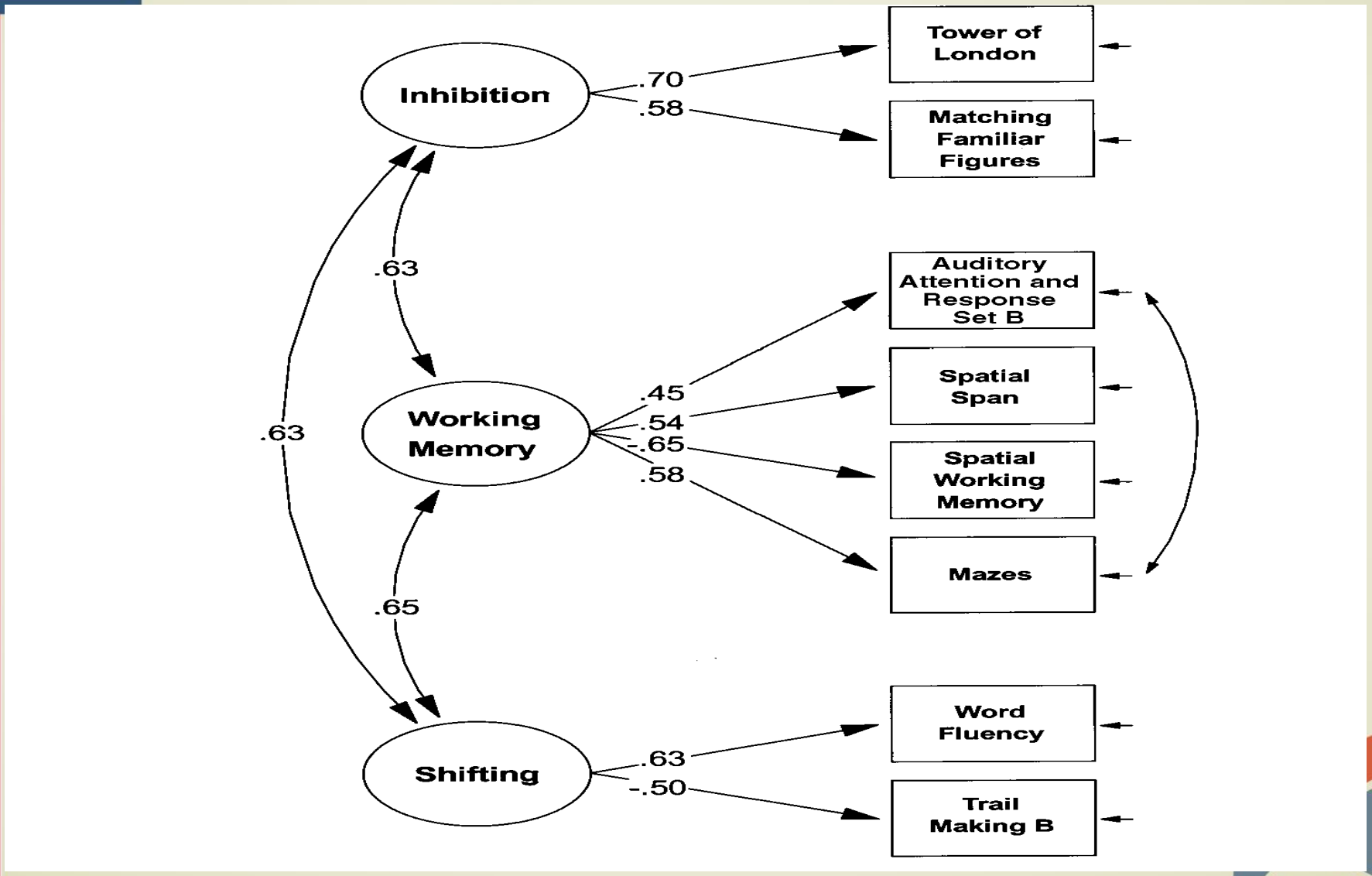
Model 3: Spatial Demands



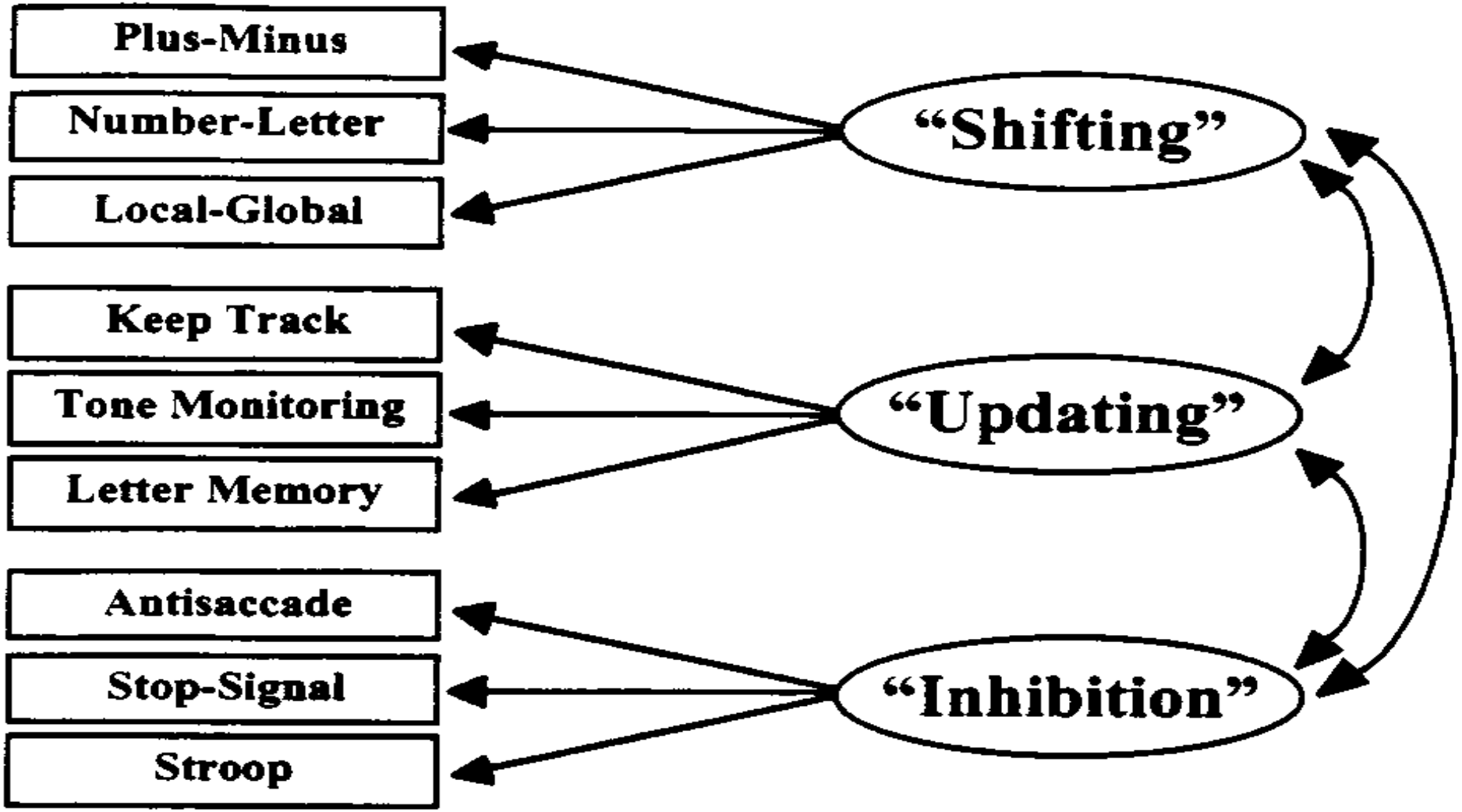
Model 4: Performance Feedback

Fig. 1. Alternative CFA models of preschool EF. 9B, Nine Boxes task; BL, Big–Little Stroop; DA, Delayed Alternation task; GNG, Go/No-Go task; NB, Nebraska Barnyard task; SD, Snack Delay task; SS, Shape School task (Inhibit condition). Standardized factor loadings and coefficients are shown.

Structure of EF: Children



Structure of EF: Adults



Participants

- 846 students from above-average risk schools
- Overlap with G4 intervention study

Variable	Percent	Test	Mean (SD)
Limited English	**23.4%**	*WJ Letter-Word*	**96.0 (13.5)**
Sex (F)	**51.5%**	*TOWRE Sight*	**87.6 (15.0)**
Ethnicity	**Hispanic 51.9%** **White 16.5%** **AAmer 29.2%**	*Gates*	**89.0 (15.0)**
Grade	**3 22.0%** **4 57.2%** **5 20.8%**	*TOSREC*	**83.4 (19.4)**
Free Lunch	**79.9%**	*WJ Calculations*	**102.0 (12.4)**

Measures

- Multiple measures of EF, several subdomains:
  - Working memory (store, manipulate, update)
  - Inhibition (prepotent)
  - Shifting (two processes, back and forth)
  - Planning (goal/problem)
  - Fluency (generative, under parameters, timed)
  - Self-Regulated Learning (reading strategies, skill/preference, self-efficacy/effort)
  - Metacognitive (& inattention)
  - Behavioral Regulation (& hyperactivity/impulsivity)

EF Latent Bifactor

- 8 factor CFA "runs" but with problems (e.g., Chi/df=2203/436; CFI .800; RMSEA=.069).
  - Latent correlations too strong and correlated errors (e.g., BR with MC; SHIFT with INHIBIT)
  - WM: storage/process and manipulation vs. updating
  - WM-SM correlates too well with PLAN (r = .96)
- 7 factor CFA fit "alright" (e.g., Chi/df=748/303; CFI=.922; RMSEA=.042)
  - Some correlations still high (r = .80, .87)
- Bifactor Version (with 5 specific) fits better (e.g., Chi/df=649/303; CFI=.940; RMSEA=.037)

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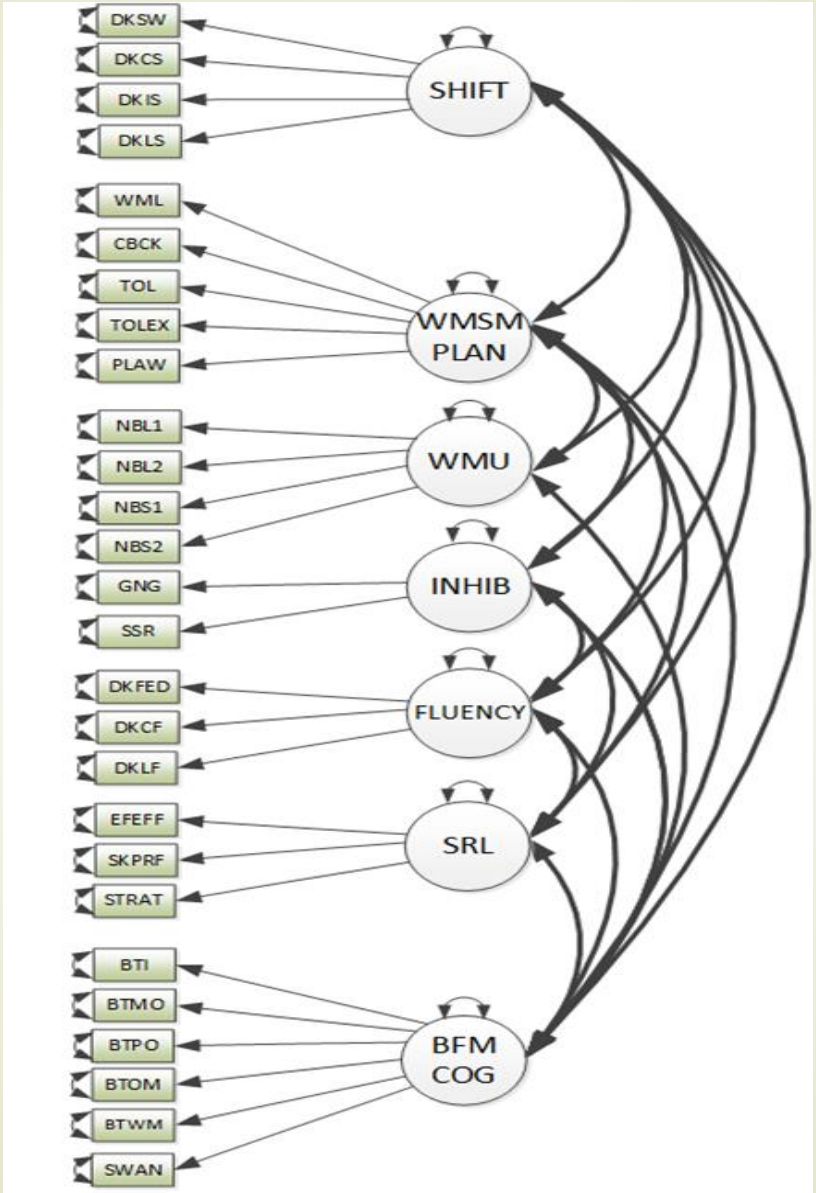
EF CFA



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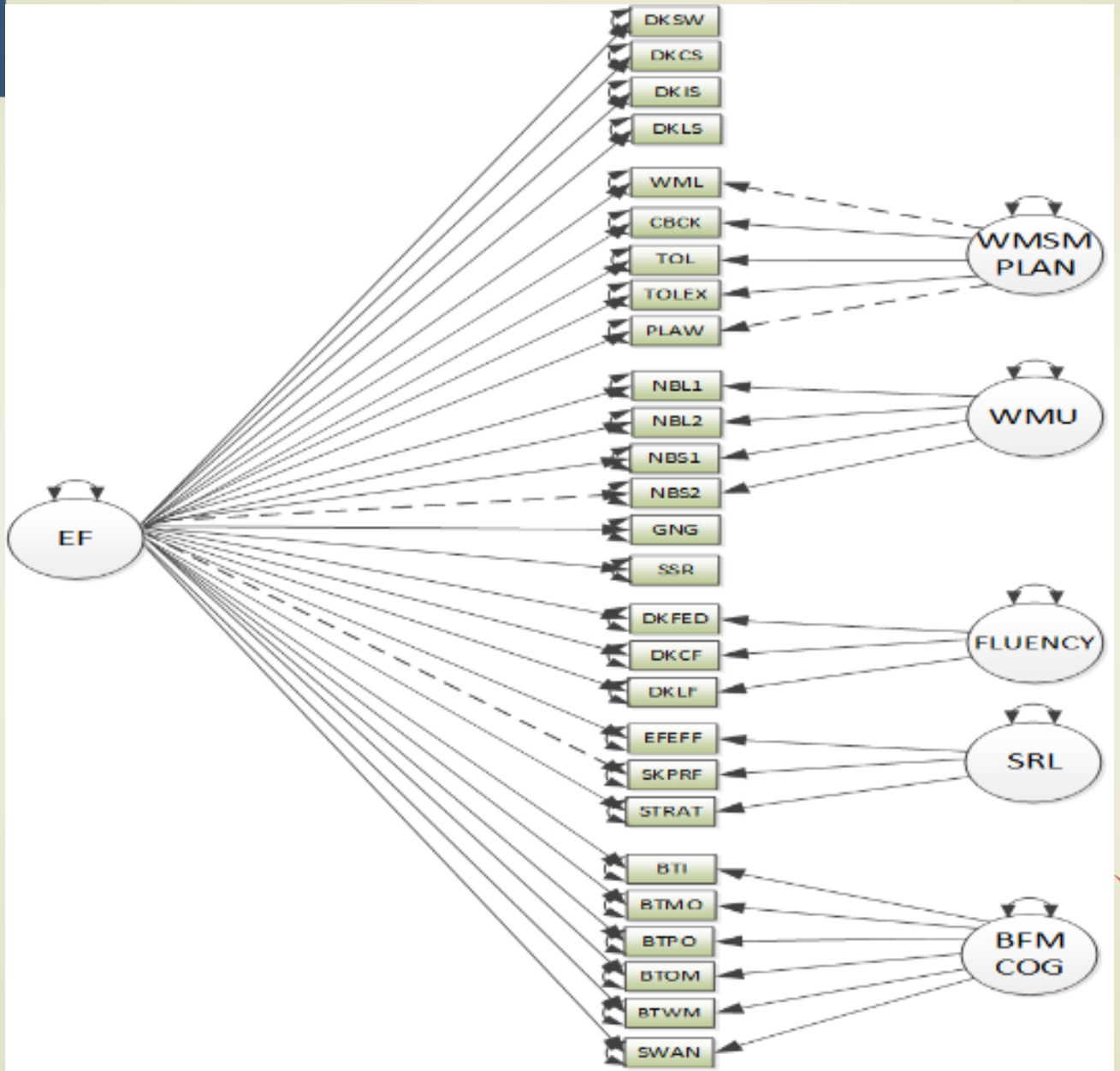
EF Latent Bifactor



EF Factor Model Summary

- Manifest variable relations low, latent variable relations high. Surprisingly consistent with other work.
- Some more general (SHIFT, INHIBIT), some more specific (WMU, SRL, BFMCOG), some both (WMSM/PLAN, FLUENCY).
- Continuum of theoretical-operational-imaging conciseness vs. potential predictive power.
- Moderators: age? population? goal?

Approaches to the Use of EF

- Description
  - This group does poorly here, ok there; this other group the opposite.
  - This brain lesion is associated with this performance
  - Structure (this study)
- Prediction
  - Performances on this task relate to this functional outcome
- Mechanism
  - The theoretical reasons and empirical means by which EF influences outcomes.
- Intervention
  - What to do about it. Implies solid information with regard to description, prediction, and mechanism.

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Thank You!

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Reading for success

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