Factor Structure and Invariance in the UDS Neuropsychological Test Battery

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No disclosures

Background

- The UDS battery was developed to tap cognitive domains affected in MCI and AD
  - Attention, speed of processing, executive function, episodic memory, and language
- The construct validity of the battery has not been formally tested

Background

- Factor analysis and invariance testing can be used to evaluate construct validity
  - Factor analysis →Validity: the battery tests what it is supposed to test
  - Invariance testing →Reliability: evidence that the factor structure is stable

Objective

- To examine the factor structure of the UDS battery and the level of invariance across groups and over time.

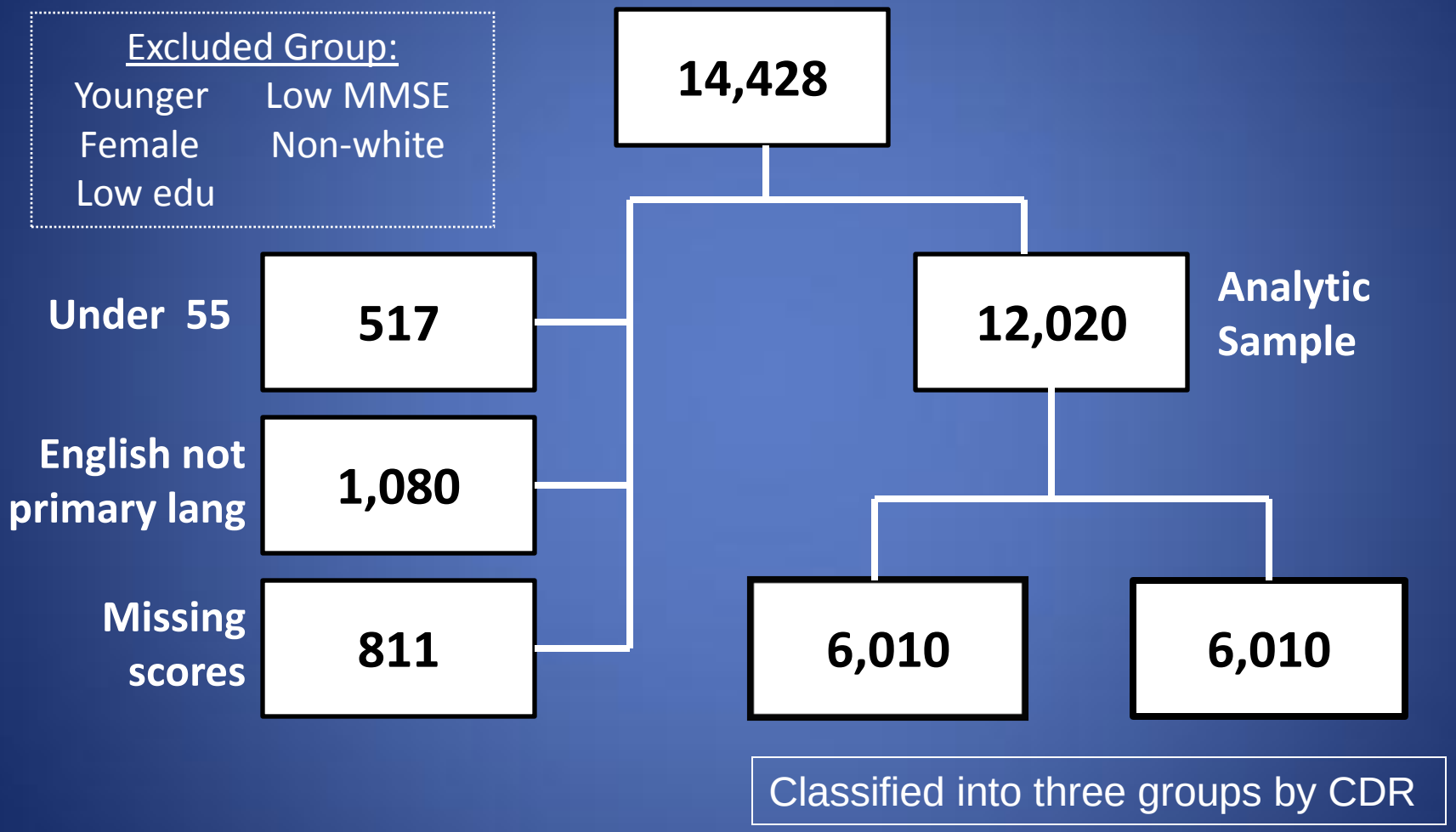
Methods

- Data from 14,428 NACC participants with initial UDS batteries as of May 5, 2008
- Protocols approved by local IRBs
- Samples drawn from clinic and community volunteers
- Informed consent obtained
- Standardized protocol administered at ADCs across the US

Statistical Analysis

- Exploratory Factor Analysis (EFA)
  - Empirical model development
- Confirmatory Factor Analysis (CFA)
  - Confirm empirical model
- Invariance Testing
  - Analyze levels of invariance across three different groups defined by CDR and over time within CDR group

Sample Selection



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Alzheimer's Disease Research Center

Sample Characteristics

Characteristic	CDR= 0.0 "Normal" N=4,780	CDR= 0.5 "MCI" N=4,081	CDR> 0.5 "Dementia" N=3,159	Total n=12,020
Baseline Age (SD)	74.7 (8.9)	75.5 (8.7)	76.9 (9.0)	75.6 (8.9)
Sex= Female (%)	3,142 (65.7)	2,072 (50.8)	1,657 (52.5)	6,871 (57.2)
Race=White (%)	3,925 (82.3)	3,450 (84.8)	2,618 (83.0)	9,993 (83.3)
Education (SD)	15.4 (2.8)	15.0 (3.2)	14.2 (3.3)	15.0 (3.1)
Baseline MMSE (SD)	28.8 (1.5)	26.4 (3.5)	19.3 (6.1)	25.5 (5.4)

Test	CDR=0.0 "Normal "	CDR=0.5 "MCI "	CDR>0. 5 "Dementia"	Total Sample N=12,020
LM Immediate Recall	13.5 (4.0)	8.7 (4.7)	3.6 (3.4)	9.4 (5.7)
LM Delayed Recall	12.15 (4.4)	6.35 (5.1)	1.51 (2.8)	7.50 (5.1)
Digits Forward	8.52 (2.0)	7.80 (2.1)	6.65 (2.4)	7.80 (2.3)
Forward Length	6.69 (1.1)	6.34 (1.2)	5.68 (1.4)	6.31 (1.3)
Digits Backward	6.74 (2.2)	5.68 (2.2)	4.06 (2.1)	5.70 (2.4)
Backward Length	4.87 (1.2)	4.31 (1.3)	3.33 (1.4)	4.28 (1.4)
Trail Making Part A	36.45 (17.2)	50.40(28.4)	84.71 (43.9)	52.64 (37.8)
Trail Making Part B	97.21(55.8)	152.05 (83.0)	227.80 (85.1)	140.94 (86.7)
Digit Symbol	45.37 (12.5)	36.15 (13.4)	21.23 (13.7)	36.28 (16.1)
Animals	19.45 (5.7)	14.96 (5.6)	8.86 (4.8)	15.21 (6.9)
Vegetables	14.35 (4.4)	10.53 (4.0)	5.87 (3.7)	10.89 (5.3)
Boston Naming	26.82 (3.6)	24.13 (5.5)	17.58 (7.8)	23.56 (6.6)

* Data transformed to correct for non-normality: Blom transformation

Exploratory Factor Analysis

Five Factor Solution

Test	Full Sample	CDR=0.0	CDR=0.5	CDR>0.5
CFI	0.999	1.0	0.999	0.998
TLI	0.997	0.998	0.996	0.993
RMSEA	0.019	0.013	0.019	0.024
SRMR	0.003	0.004	0.004	0.006

CFI: Comparative Fit Index >=0.90

TLI: Tucker-Lewis Index >= 0.90

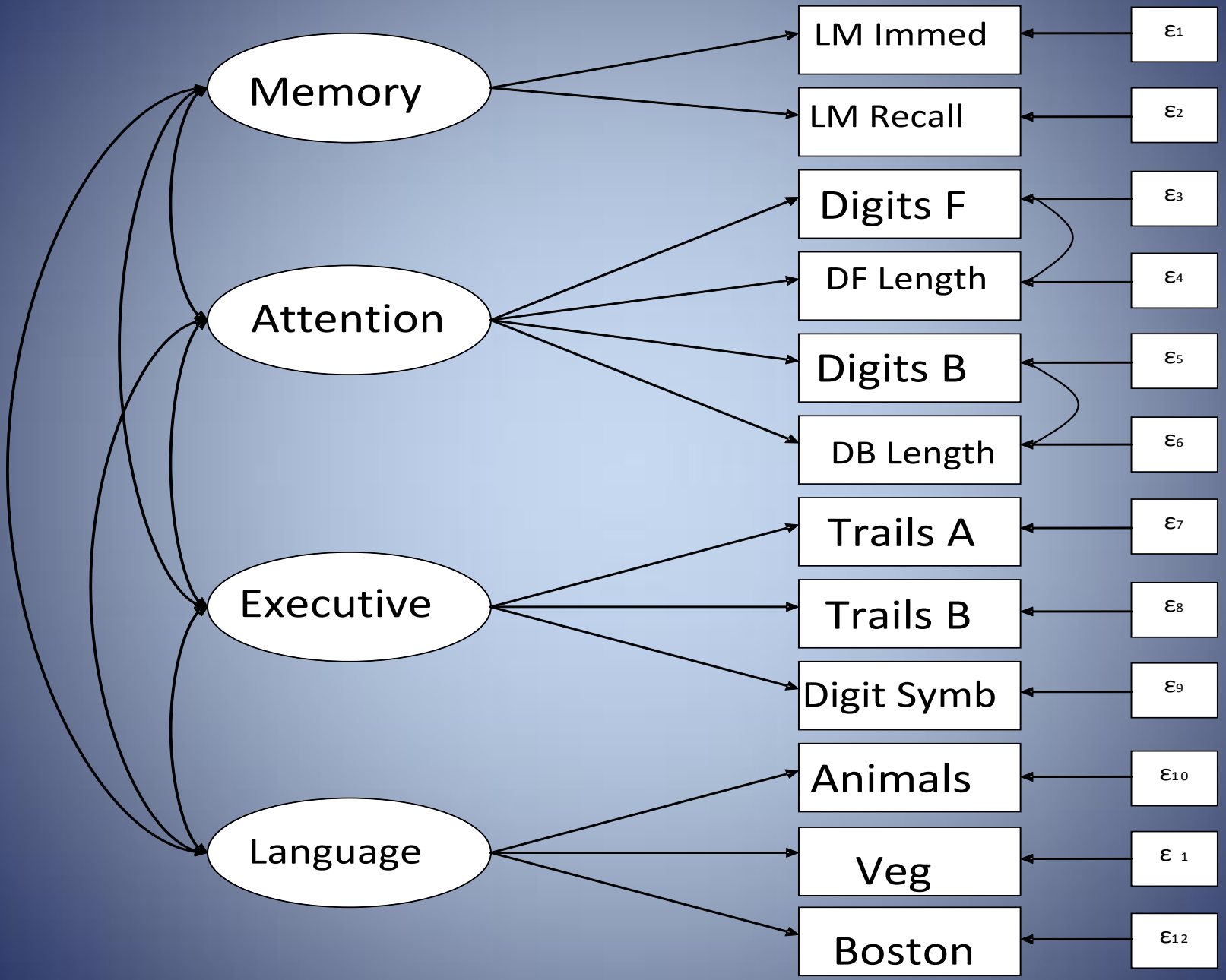
RMSEA: Root mean square error of approx <=0.05

SRMR: Standardized root mean square residual <=0.05

Confirmatory Factor Analysis

Test	Full Sample		Multiple Group
	5 Factor	4 Factor	
CFI	**0.848**	0.989	0.985
TLI	**0.833**	0.985	0.978
RMSEA	**0.128**	0.045	0.047
SRMR	**0.381**	0.019	0.029

Model constraints: means=0, variances=1.0


Memory
Attention
Executive
Language
LM Immed
LM Recall
Digits F
DF Length
Digits B
DB Length
Trails A
Trails B
Digit Symb
Animals
Veg
Boston
ε1
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ε3
ε4
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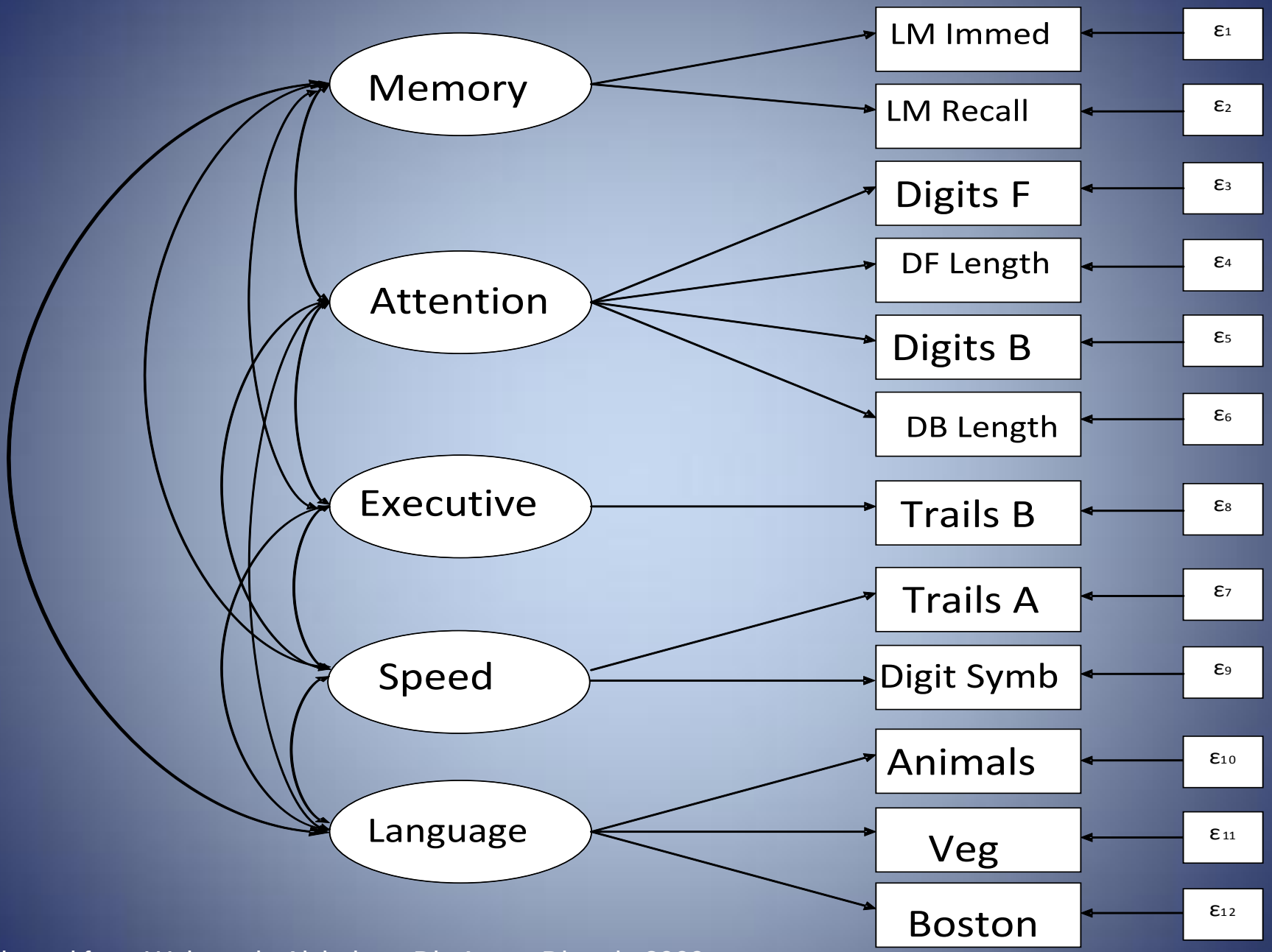
ε8
ε9
ε10
ε 1
ε12



Adapted from Weintraub, Alzheimer Dis Assoc Disord , 2009

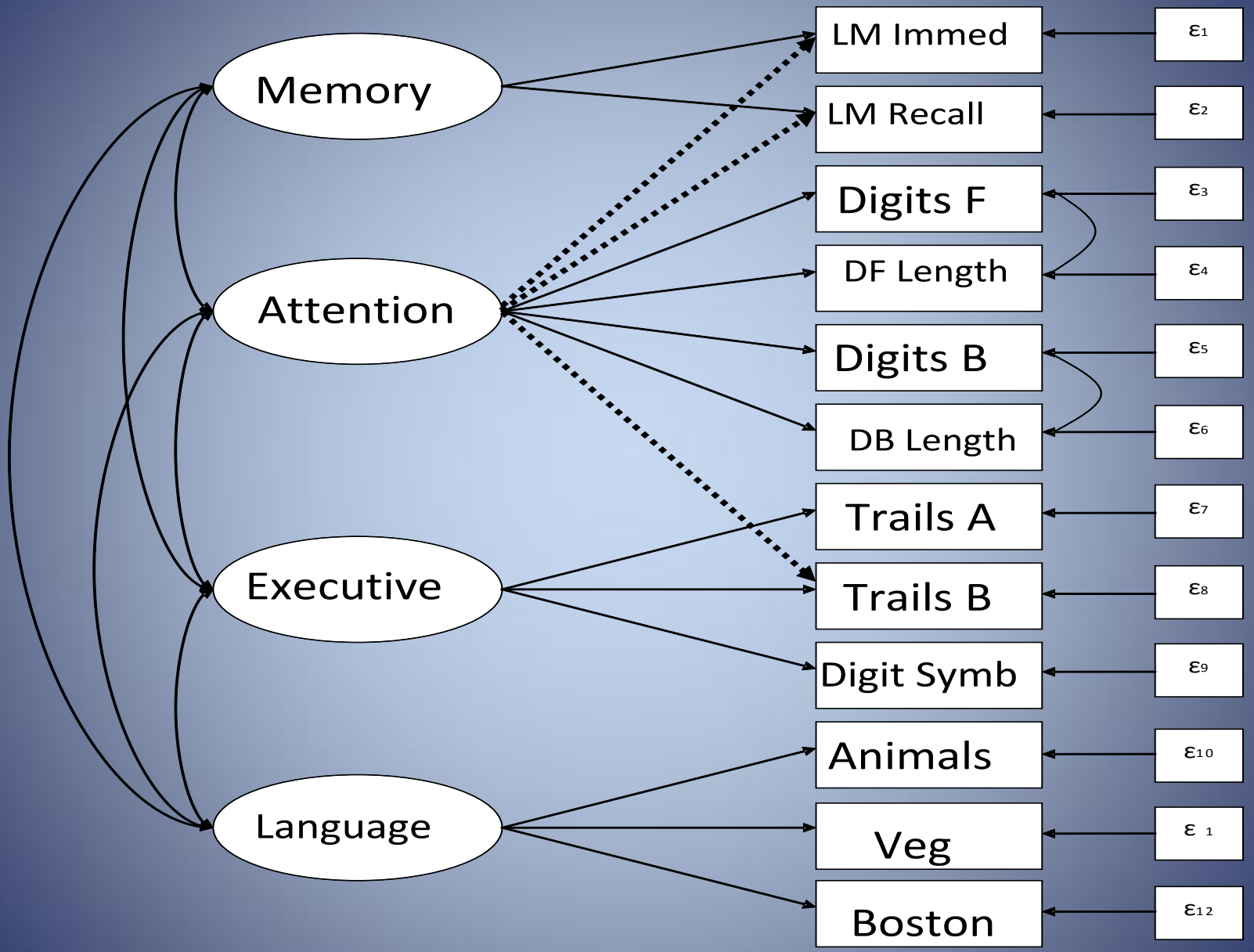
Invariance Testing

- **Dimensional:** common factors
- **Configural**: same factors
- **Metric**: factor loadings
- **Strong:** factor loadings and intercepts
- **Strict:** factor loadings, intercepts, and residual variances

Results

	Model 1 Configural Invariance	Model 2 Metric Invariance	Model 3 Strong Invariance	Model 4 Strict Invariance
CFI	0.985	0.975	0.967	0.957
TLI	0.978	0.969	0.963	0.958
RMSEA	0.047	**0.055**	**0.060**	**0.064**
SRMR	0.029	**0.065**	**0.072**	**0.071**
BIC	-460.77	-254.30	-70.33	**112.90**

BIC: Bayesian information criterion <0.0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ε1
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ε6
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ε8
ε9
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ε 1
ε12

Results

	Model 3 Strong Invariance	Model 3 Mods Strong Invariance	Model 4 Strict Invariance	Model 4 Mods Strict Invariance
CFI	0.967	0.978	0.957	0.968
TLI	0.963	0.975	0.958	0.968
RMSEA	**0.060**	0.050	**0.064**	**0.056**
SRMR	**0.072**	0.051	**0.071**	0.052
BIC	-70.33	-473.10	**112.90**	-267.17

Results
Over 1 year lag time

Strict Invariance Models	CDR=0.0	CDR=0.5	CDR>0.5
CFI	0.984	0.984	0.988
TLI	0.983	0.983	0.987
RMSEA	0.042	0.040	0.038
SRMR	0.030	0.033	0.036
BIC	-390.92	-536.81	-601.56

Limitations

- Specialized sample
  - Clinic based samples
  - Community volunteers
- Classification with CDR
- Limitations of the tests and battery

Conclusions

The NACC battery factor structure

- Approximates the hypothesized model
- Approaches the level of strict invariance
- Demonstrates invariance within group over a 1 year lag time.

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