Path Model Fit with SEM: Introducing a New Package for LAVAAN

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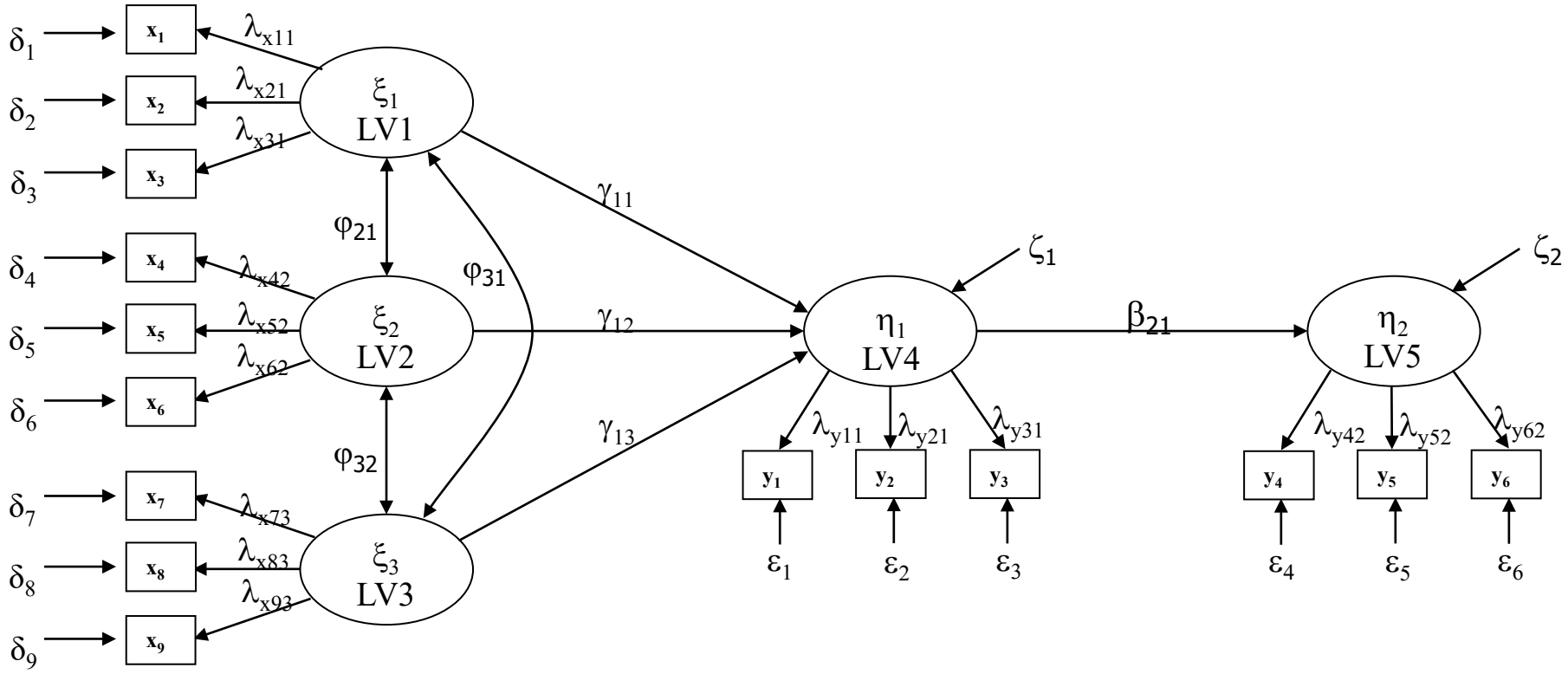
Figure 1: Example M_T = Theoretical Model



I. Introduction

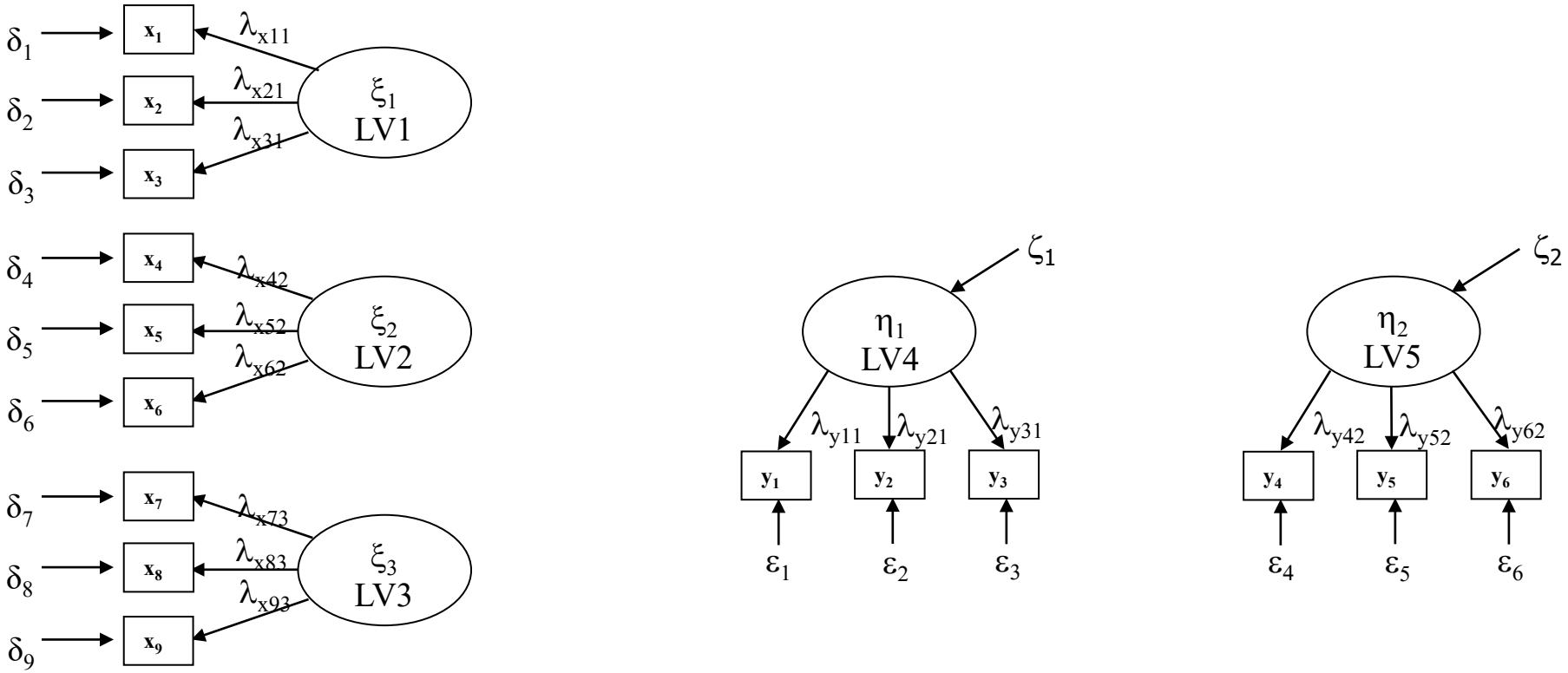
A. Latent variable models prevalent in organizational research

B. Global fit measures popular (CFI, RMSEA, SRMR)
   Evaluate entire composite model (see example M_T)

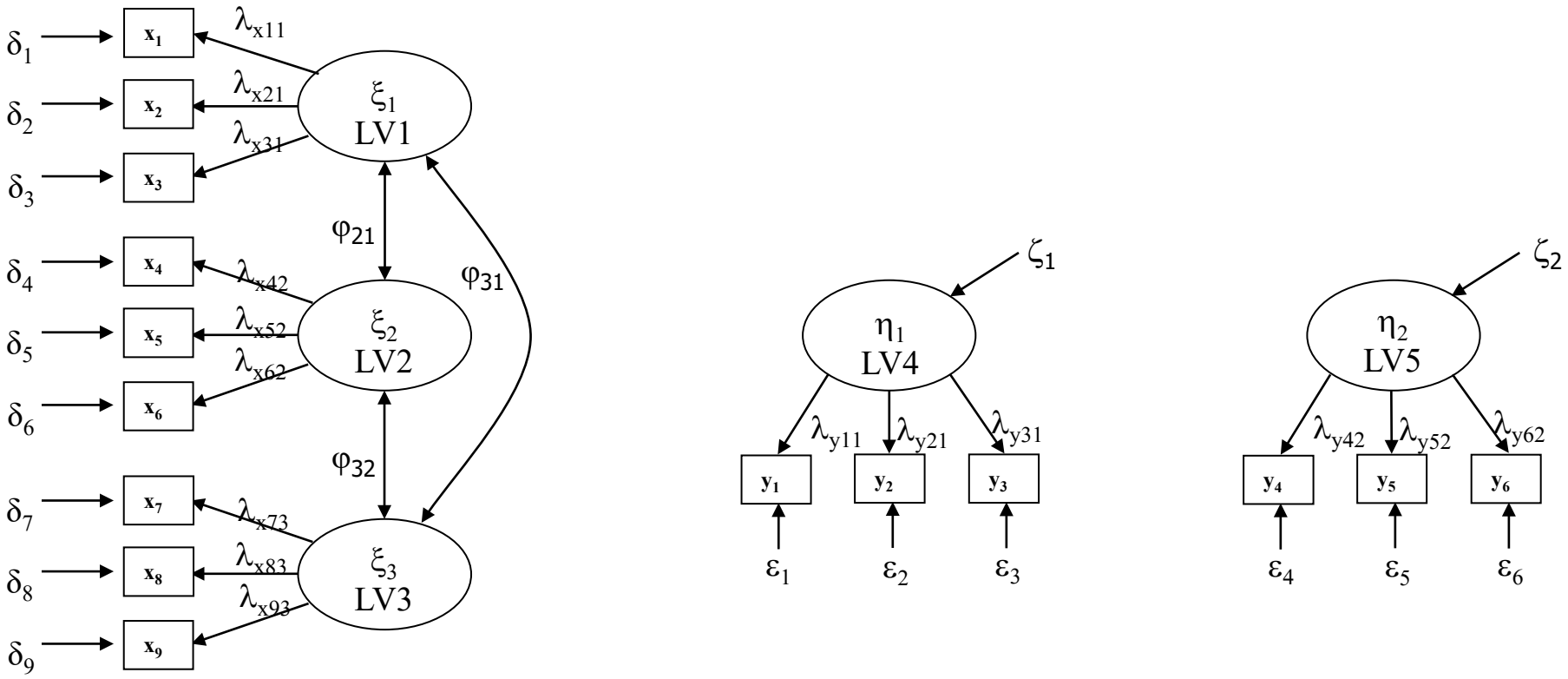
C. Researcher's strongest interest is in "path model"
   Part of model most closely aligned with theory testing
   Example: 4 paths in, 3 paths out of model (both are hypotheses)

D. Global fit measures- NOT best approach to path model evaluation
   Need indices that focus on the path model component

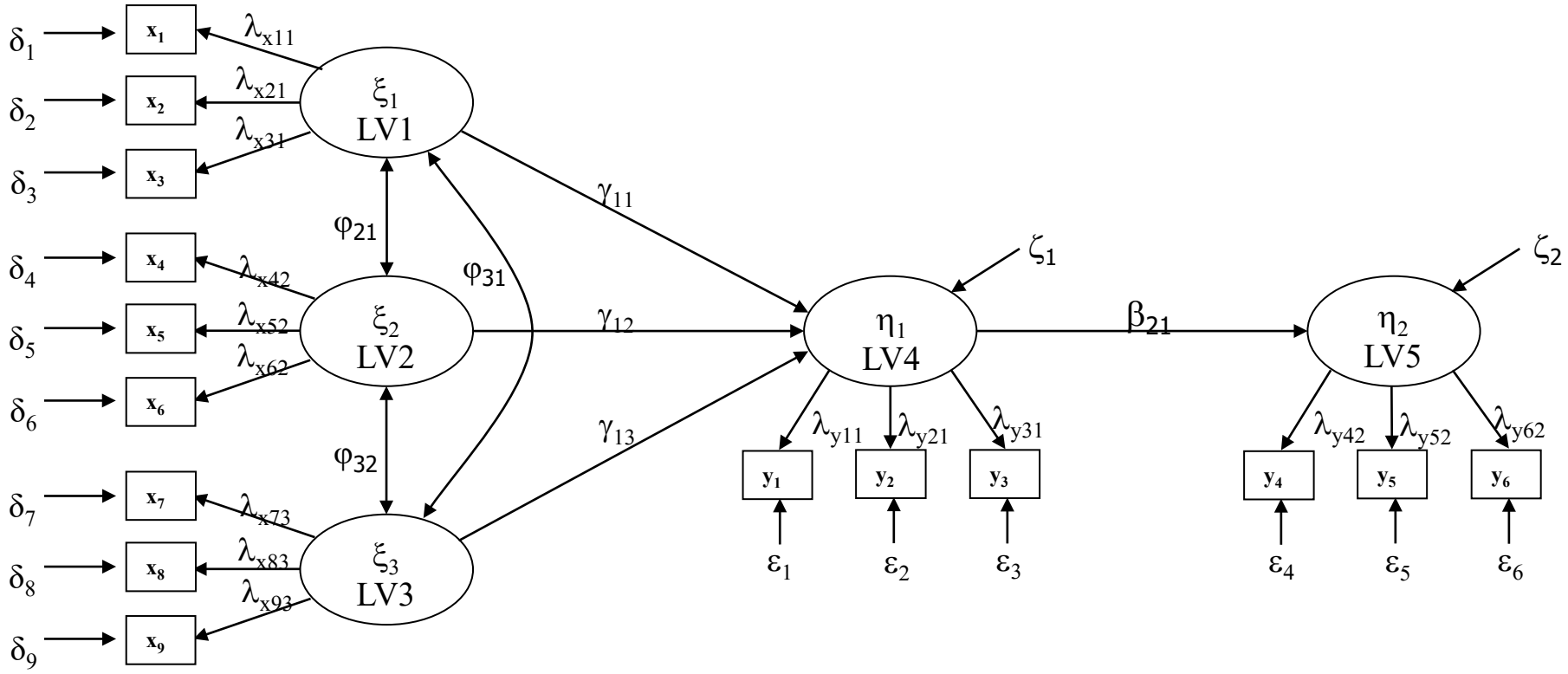
M_{UF} = Uncorrelated Factor Model



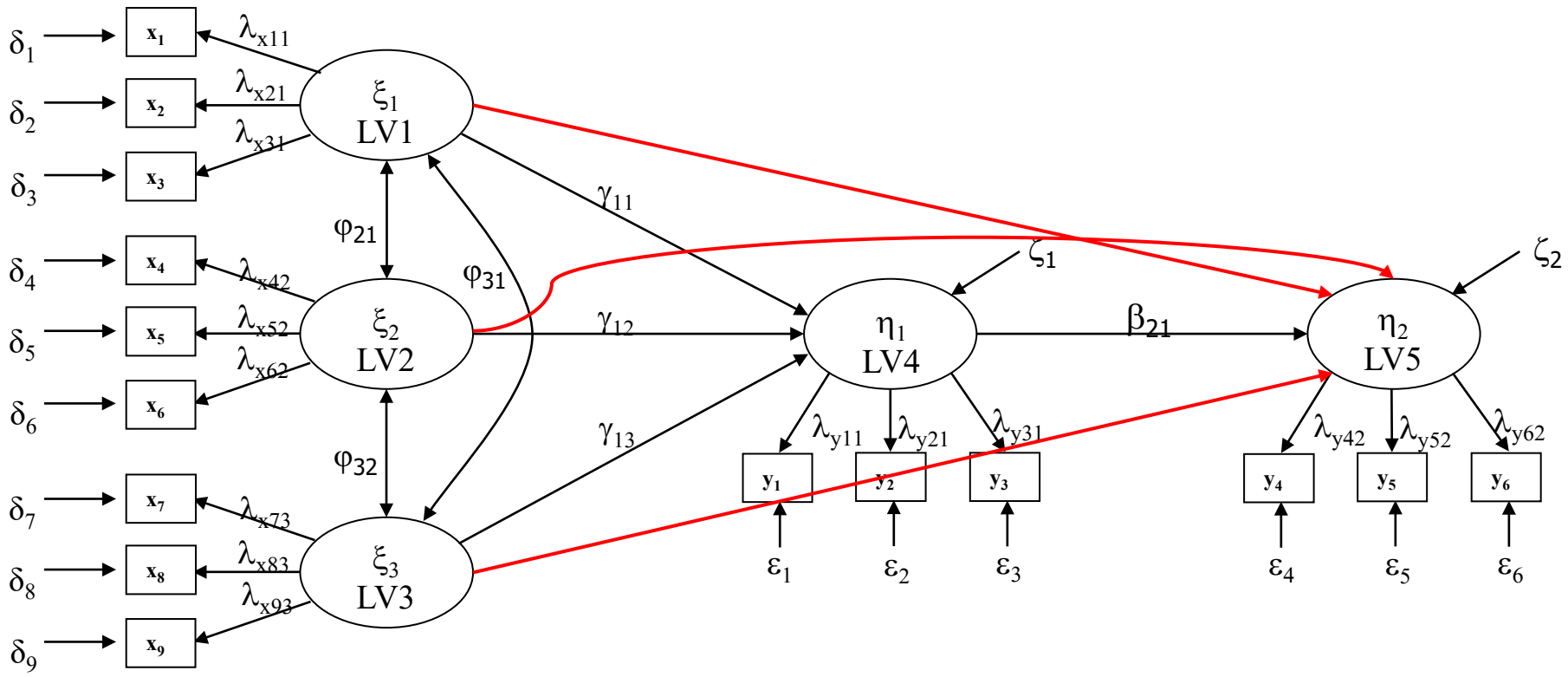
M_{SN} = Structural Null Model

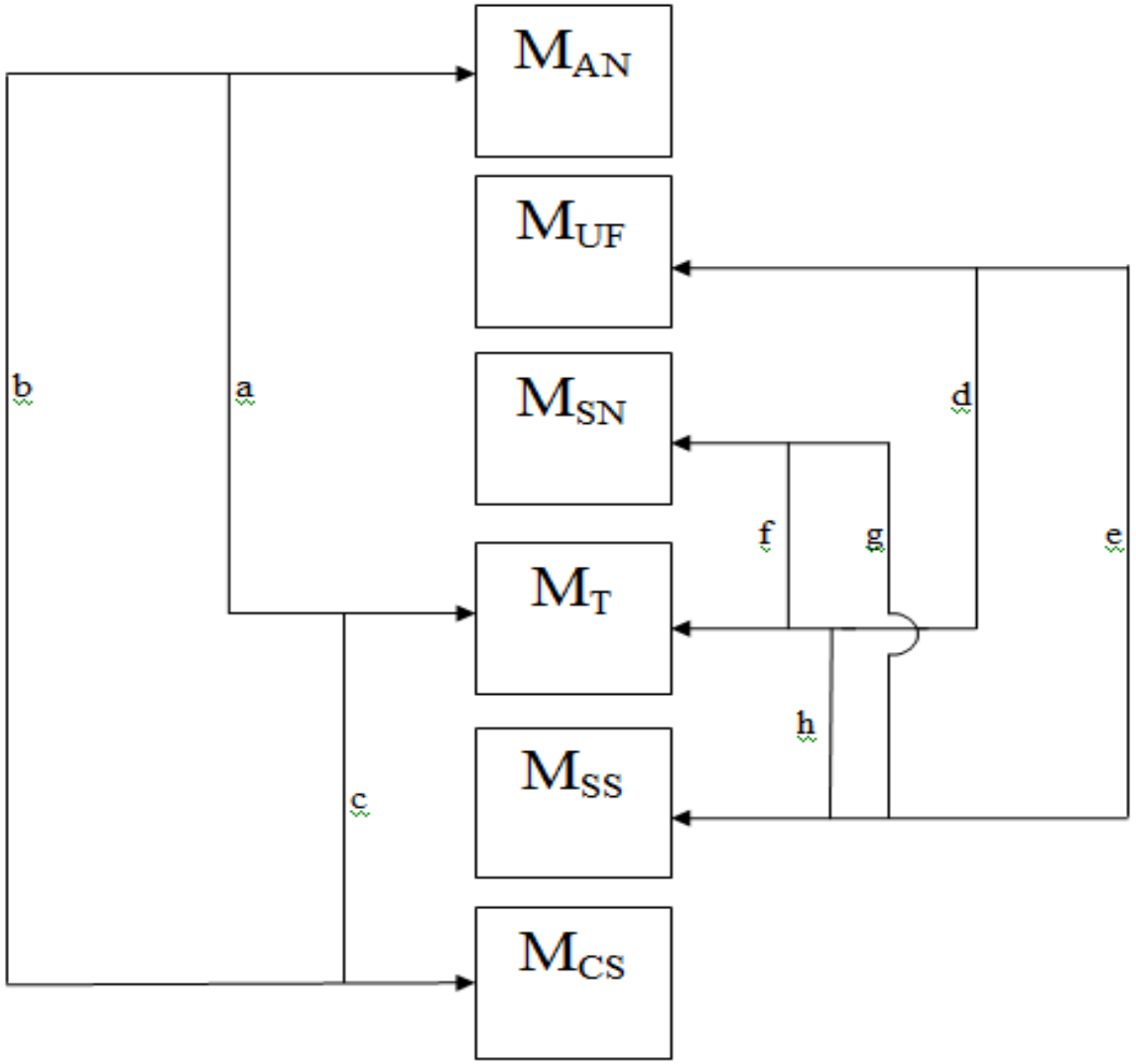


M_T = Theoretical Model (4 paths in, 3 paths out)



M_{SS} = Saturated Structural Model (adds 3 paths; =M_{CFA})





AN: Absolute Null
Worst possible model, highest χ^2 and df

UF: Uncorrelated Factors
Latent variables unrelated

SN: Structural Null
No causal paths linking latent variables [no gammas (γ) or betas (β), does include correlations among exogenous latent variables]

T: Theoretical (Composite)

SS: Saturated Structural
All possible causal paths linking latent variables; χ^2, df = Measurement Model (M_M)

CS: Completely Saturated
Best possible model χ^2 and df = 0

Figure 2. Williams & O'Boyle (2011)

CFI: a/b RMSEA: c NSCI-P: f/g RMSEA-P: h

II. Problems with Global Fit Indices (CFI, RMSEA, SRMR)

A. Values strongly influenced by measurement model (how many LVs, how many indicators) and number of correlated exogenous LVs

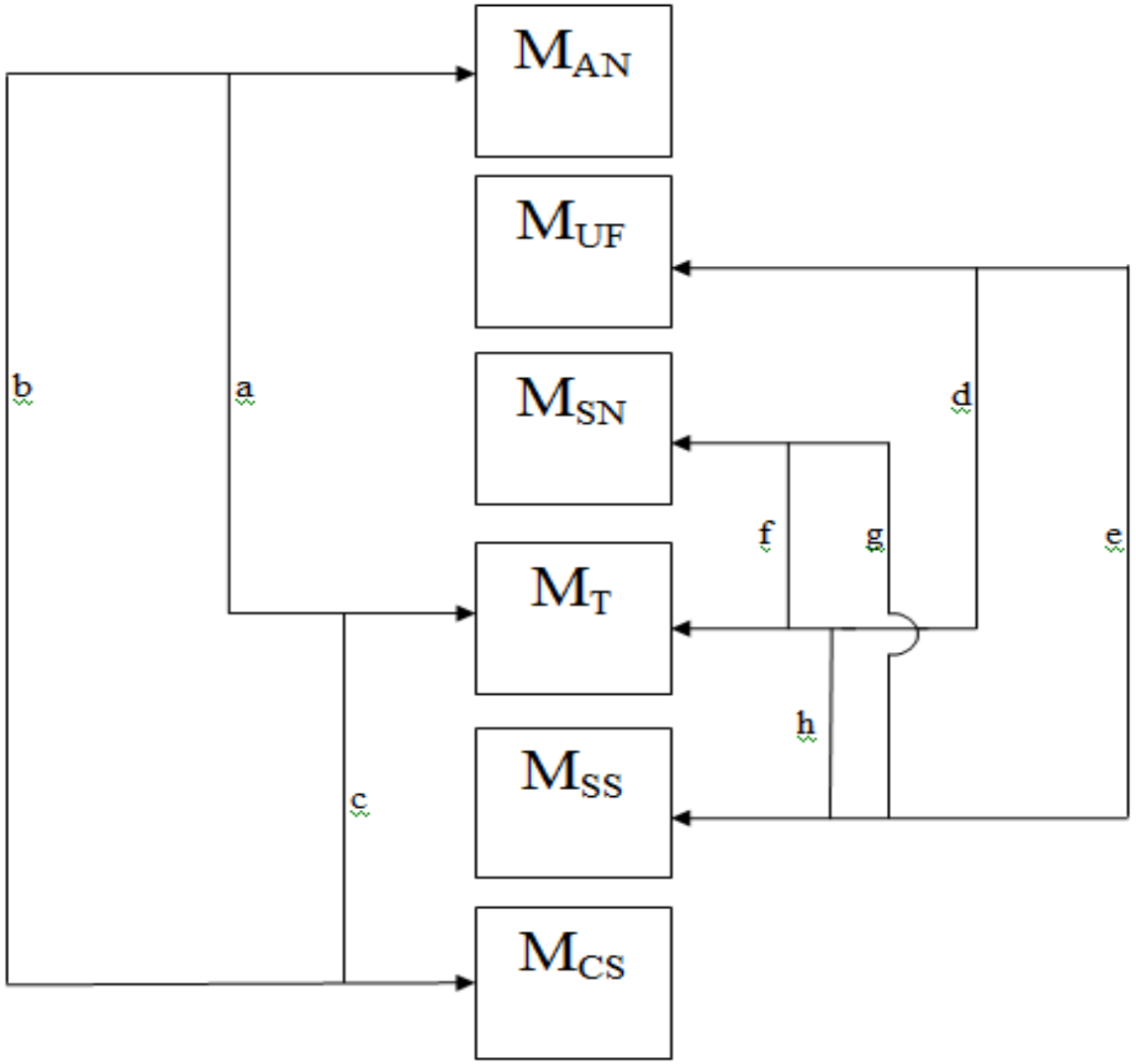
B. Thus, in simulation research models with major path misspecifications can show global fit that meets target values:

Williams & O'Boyle (2011), Lance et al. (2016), Williams, Williams, & O'Boyle (2020). See Table 1 summary table.

C. Results from published studies show that accepted models have mis-specifications and their conclusions are likely biased (O'Boyle & Williams, 2011; Williams, O'Boyle, and Yu, 2020)

Table 1. Summary of Results Williams & O'Boyle (2011) Simulation

Ex	Author	CFI-UF	CFI-SN	Retained	Models
				CFI	RMSEA
1	Duncan (1971)	.40	.57	T-4	T-4
2	Ecob (1987)	.70	.74	T-6	T-5
3	Mulaik 2 (1989)	.58	.61	T-2	T-5
4	Mulaik 4 (1989)	.80	.82	T-4	T-7
5	MacCal 2 (1986)	.62	.66	T-2	T-2
6	MacCal 4 (1986)	.82	.83	T-3	T-4



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III. New fit indices for path model evaluation

Previous work by Sobel and Bohrnstedt (1985), Mulaik et al. (1989), Williams & Holahan (1994), McDonald & Ho (2002); introduced by Williams & O'Boyle (*ORM*, 2011)

RMSEA-P = $\{[\chi^2_P - df_P] / [df_P (N-1)]\}^{1/2}$,

where χ^2_P and df_P are calculated as χ^2 and df differences between measurement (M_{SS}) and composite (M_T) models

< .05 close fit, < .08 good fit, >.10 poor fit

90% conf. interval: retain M_T if low end <.05 or high end < .10

NSCI: Noncentrality Structural Covariance Index

$[(\chi^2_{SN} - \chi^2_T) - (df_{SN} - df_{SS})] / [(\chi^2_{SN} - \chi^2_{SS}) - (df_{SN} - df_{SS})]$

Incorporates M_{SN}- Structural Null Model

IV. Challenges in Implementing Use of Path Model Fit Indices

A. Requires running three models: M_T , M_{SS} , M_{SN}

B. Requires manually retrieving chi-square and df for these models

C. Requires calculations with Xcel (confidence interval complicated)