Introduction to Structural Equation Modelling (SEM)

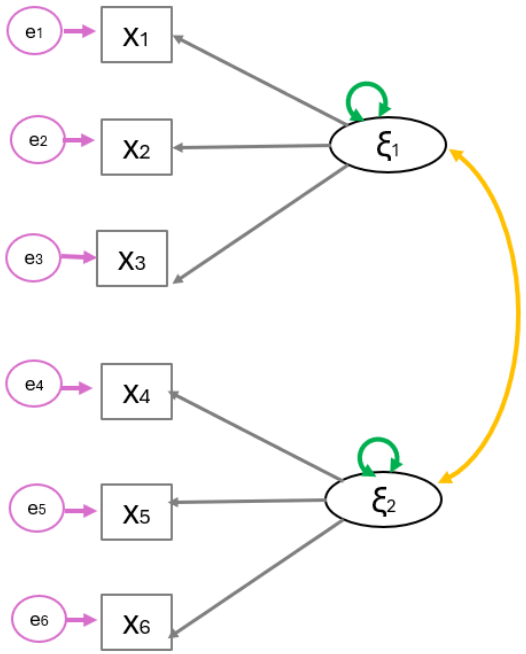
Konstantinos I. Bougioukas, MSc, PhD

School of Psychology
Faculty of Philosophy
Aristotle University of Thessaloniki

Structural Equation Modelling

Integration of **CFA (Latent variables)** with **Path Analysis (exogenous endogenous variables)**

CFA



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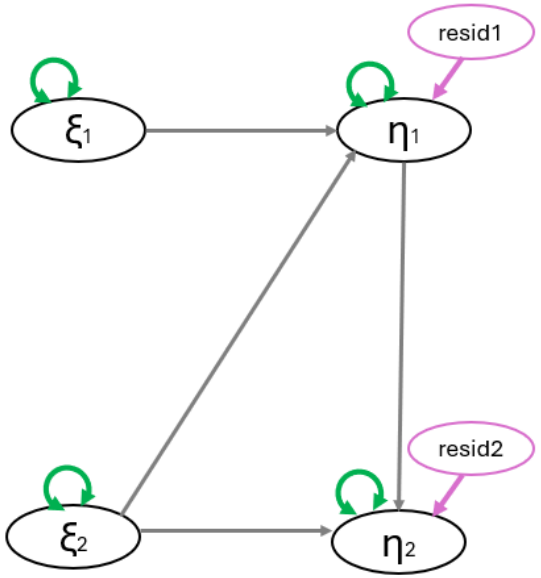
Direct and Indirect Paths



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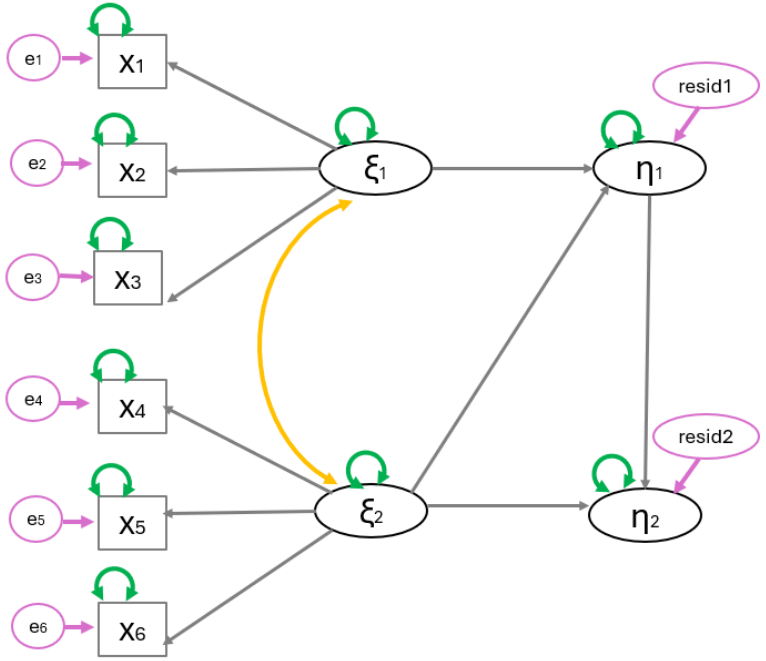
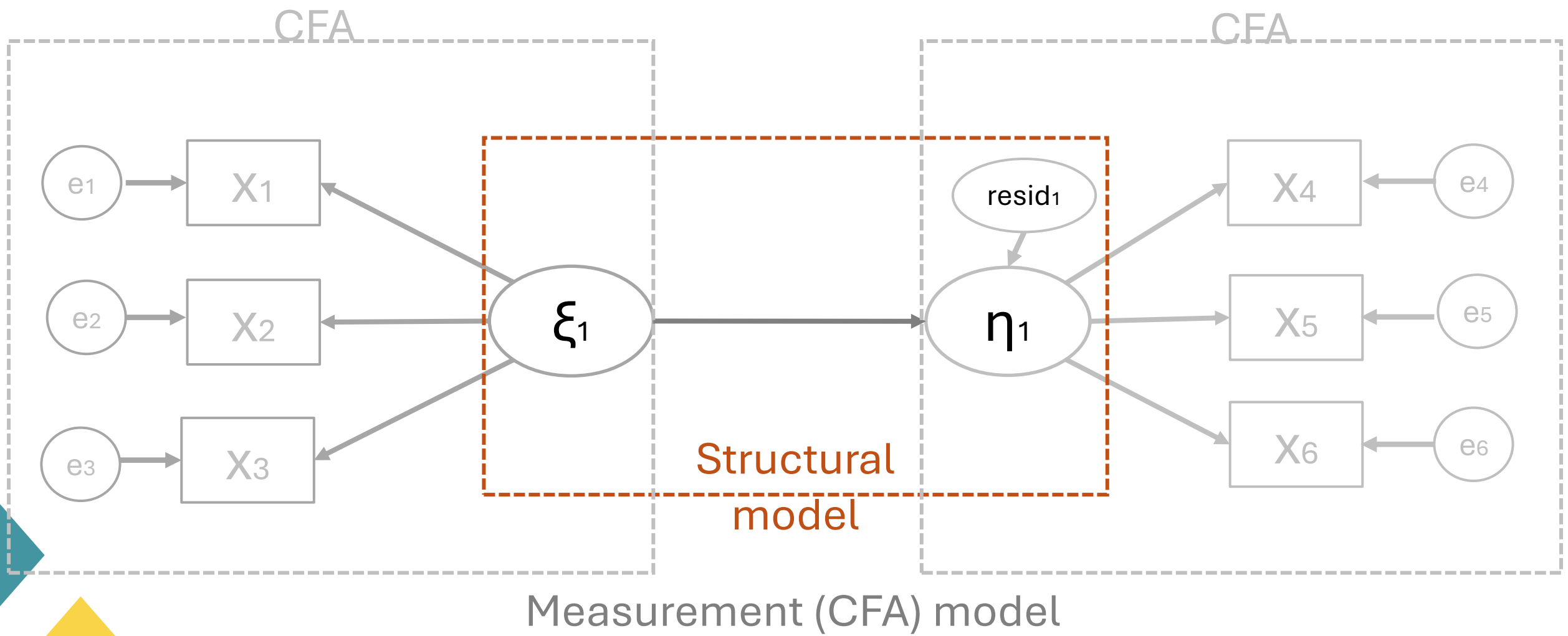
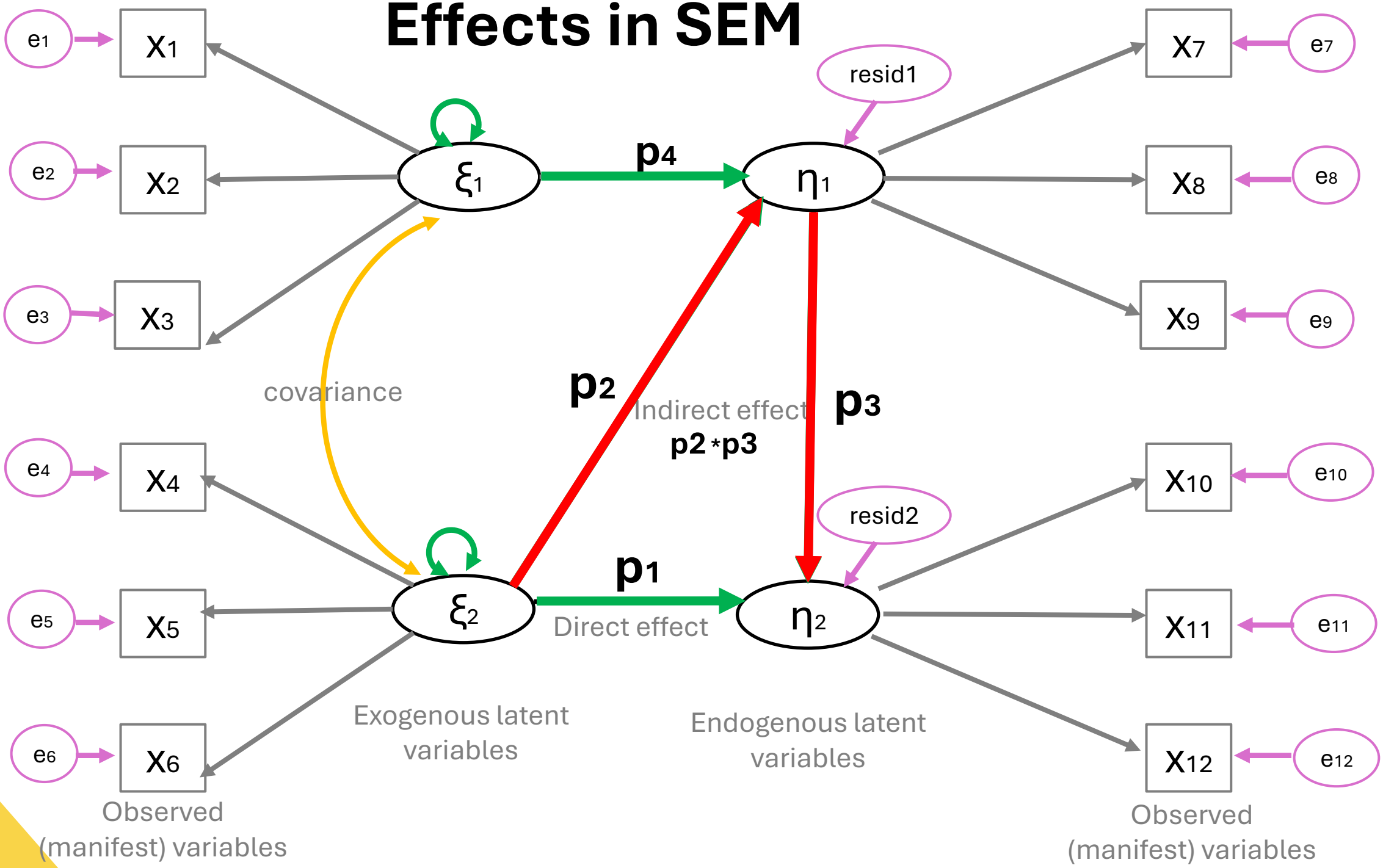
SEM



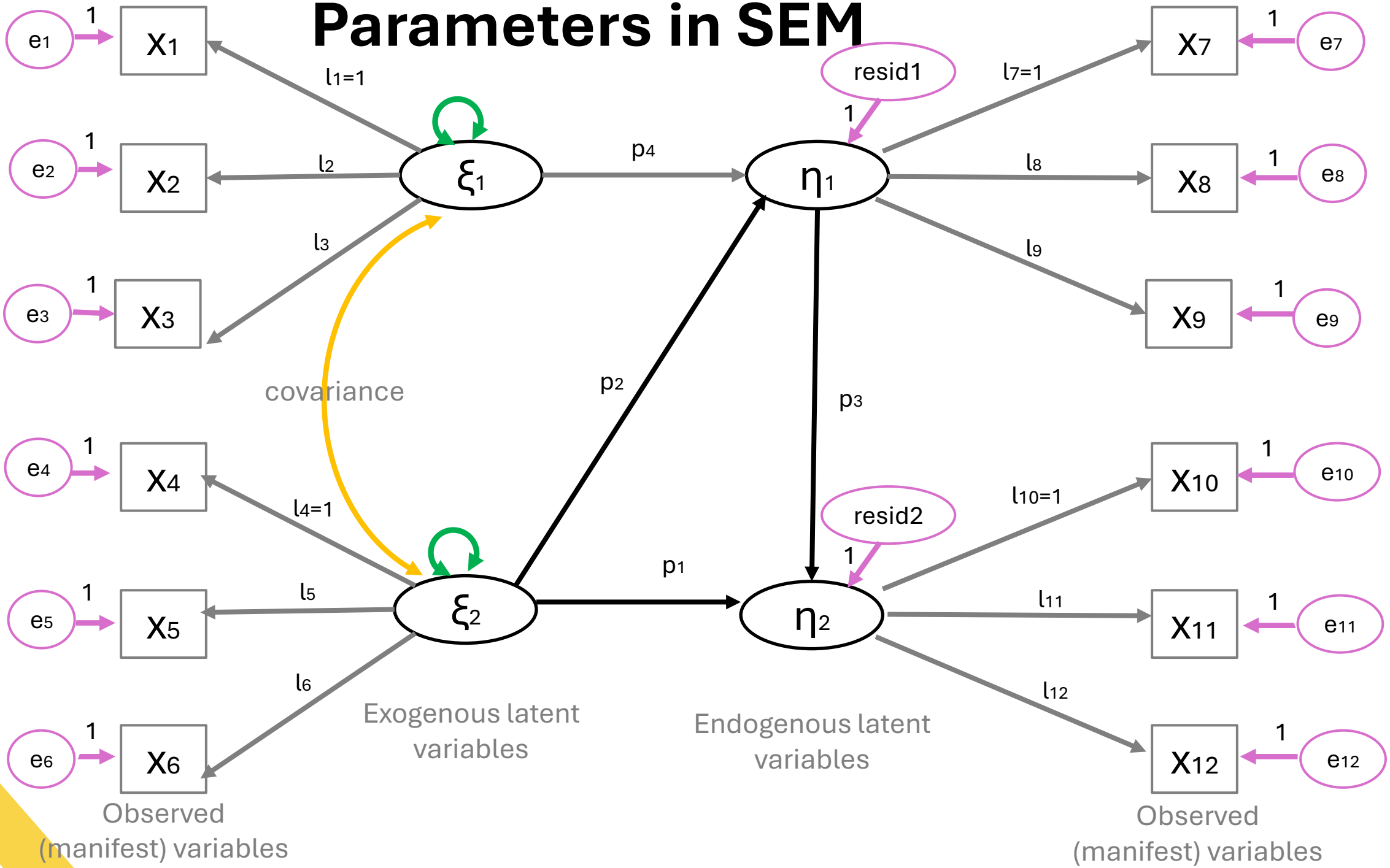
Measurement and Structural Models



Effects in SEM



Parameters in SEM



Steps in SEM

1. **Model specification:** Define the hypothesized associations between variables based on theory.

2. **Model identification:** Determine whether there is sufficient information in the observed data to estimate the model's parameters.

3. **Model estimation:** Use statistical techniques to calculate the values of model parameters.

4. **Assess goodness of fit:** RMSEA, CFI, TLI

5. **Model respecification:** Modify the model to improve its fit to the data after initial estimation.

EXAMPLE of a simple SEM

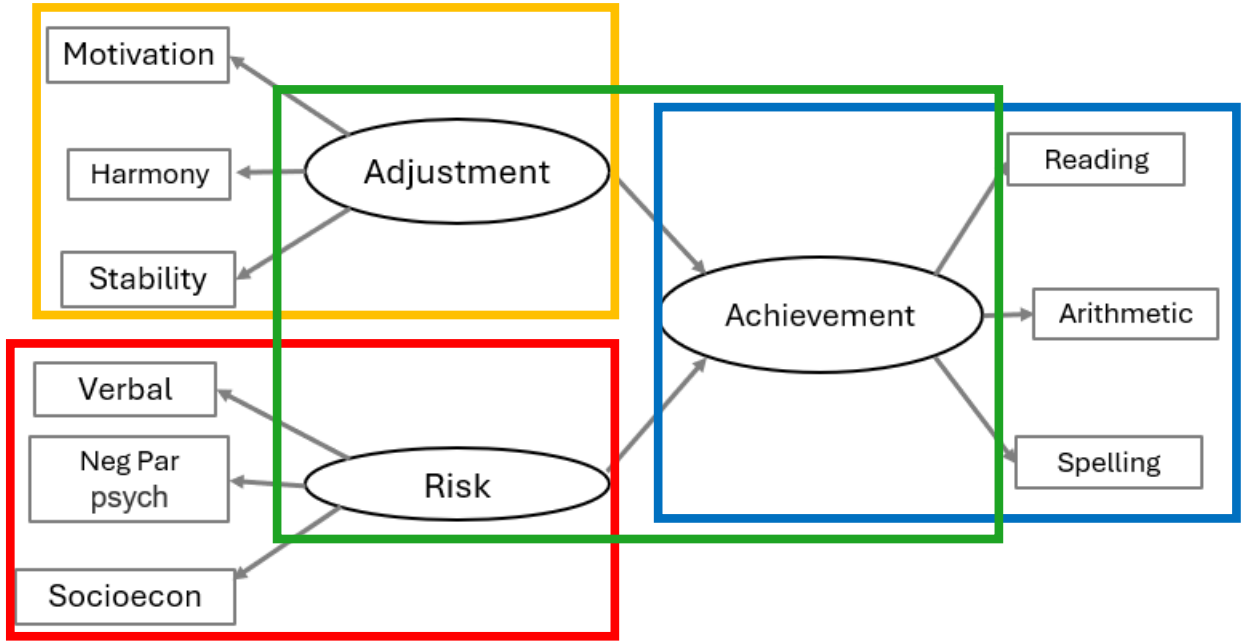
The theoretical framework for our example is grounded in understanding how various student background factors influence academic achievement.

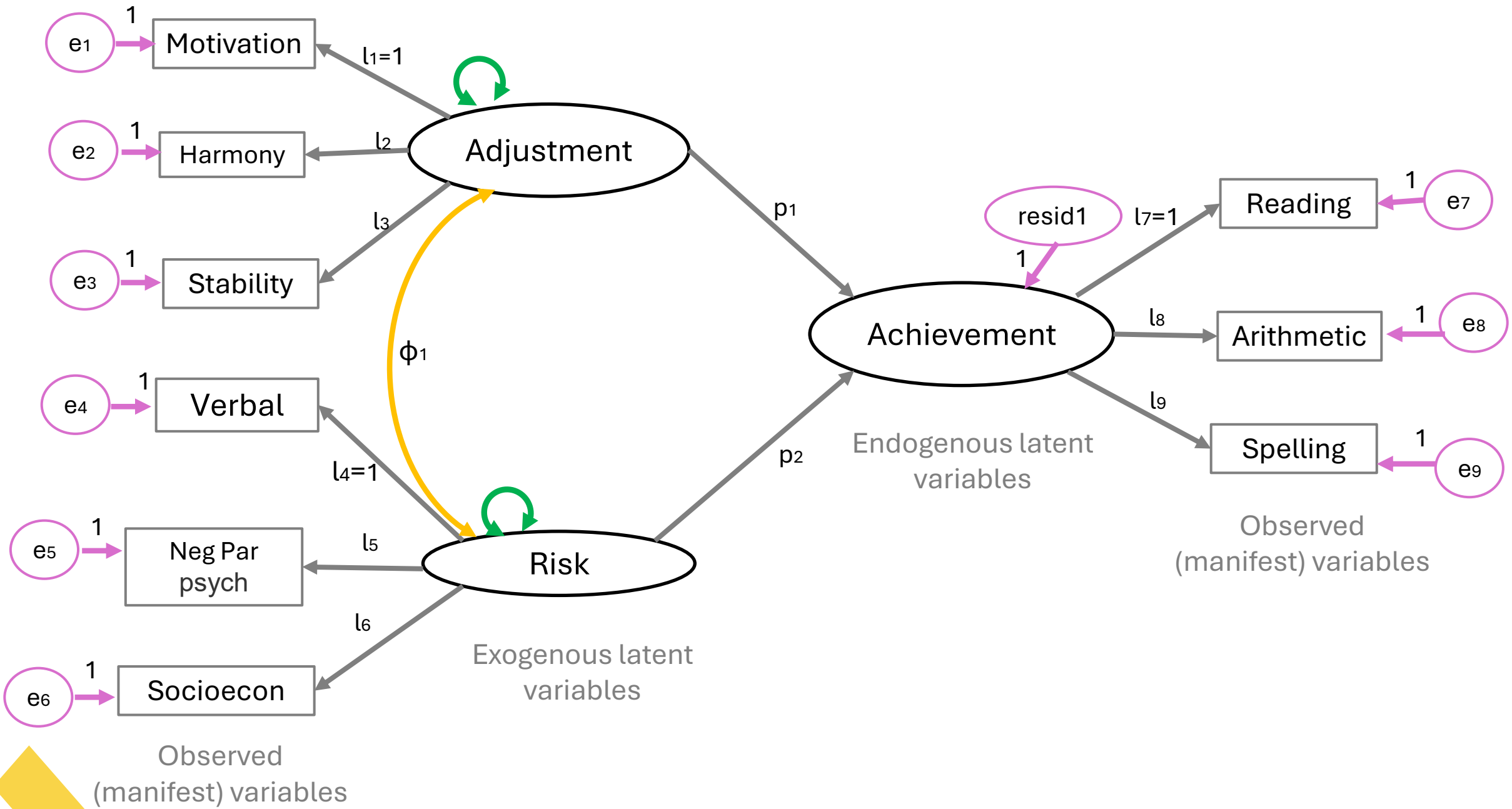
The observed variables are:

- motivation (motiv)
- harmony (harm)
- stability (stabi)
- negative parental psychology (ppsych)
- socioeconomic status (ses)
- verbal IQ (verbal)
- reading (read)
- arithmetic (arith)
- spelling (spell)

The three hypothesized latent constructs are:

- Adjustment
- Risk
- Achievement

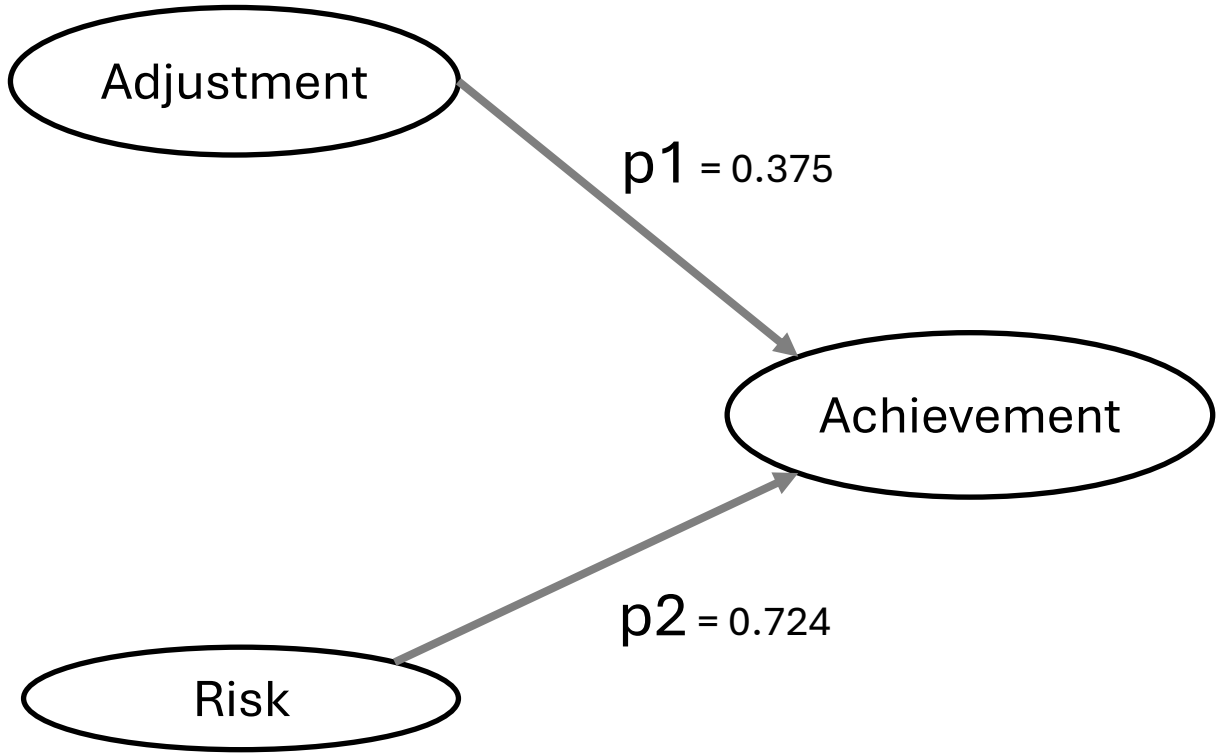



e1
1
Motivation
l1=1
e2
1
Harmony
l2
Adjustment
e3
1
Stability
l3
ϕ1
e4
1
Verbal
l4=1
e5
1
Neg Par psych
l5
Risk
l6
e6
1
Socioecon
Observed (manifest) variables
Exogenous latent variables
p1
p2
resid1
1
l7=1
Reading
1
e7
Achievement
l8
Arithmetic
1
e8
l9
Spelling
1
e9
Endogenous latent variables
Observed (manifest) variables

Path coefficients

Parameters estimates

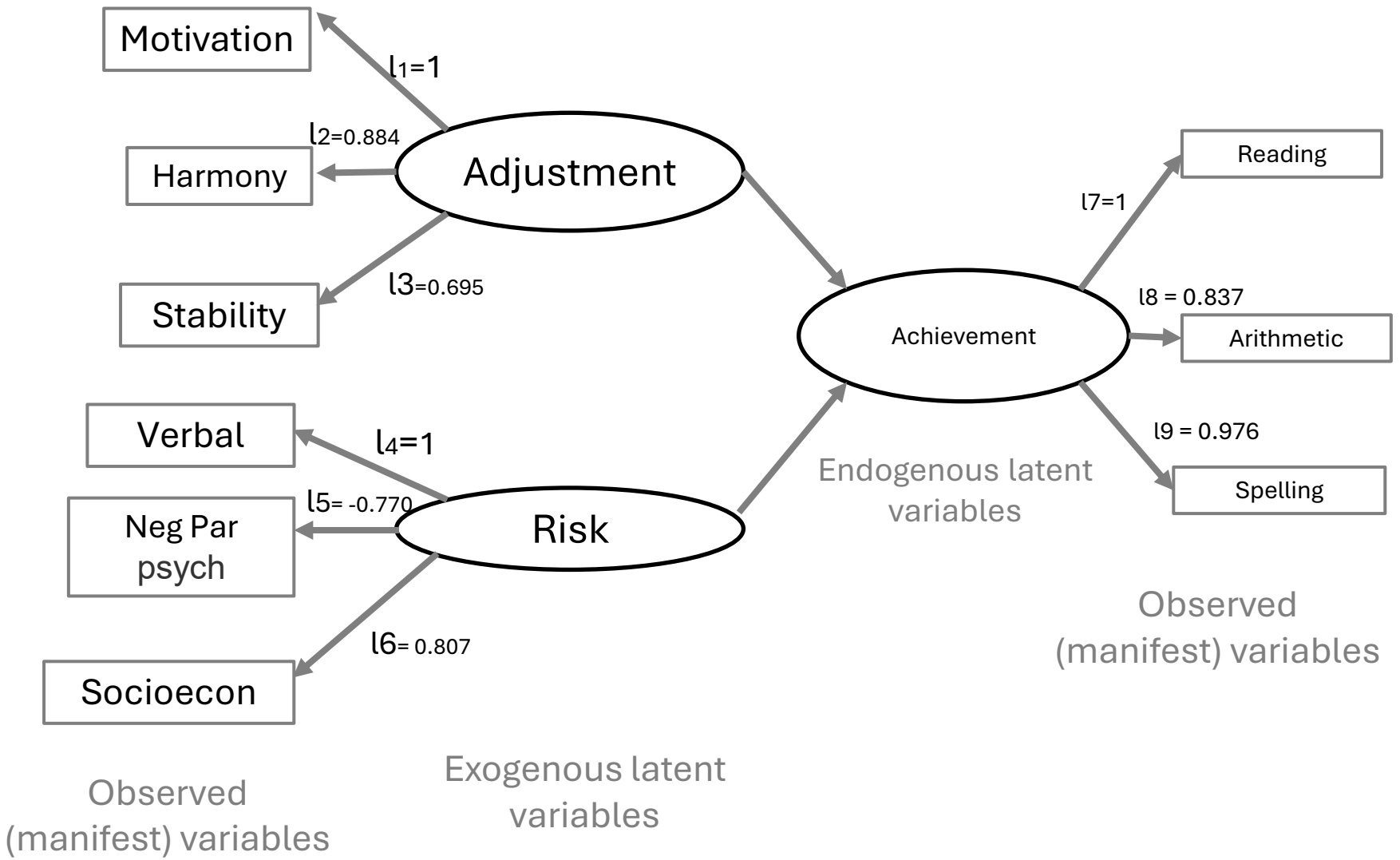
Dep	Pred	Estimate	SE	95% Confidence Intervals Lower	95% Confidence Intervals Upper	β	z	p
Achievement	Adjustment	0.375	0.046	0.284	0.466	0.372	8.085	< .001
Achievement	Risk	0.724	0.078	0.571	0.878	0.564	9.253	< .001



Factor Loadings

Measurement model

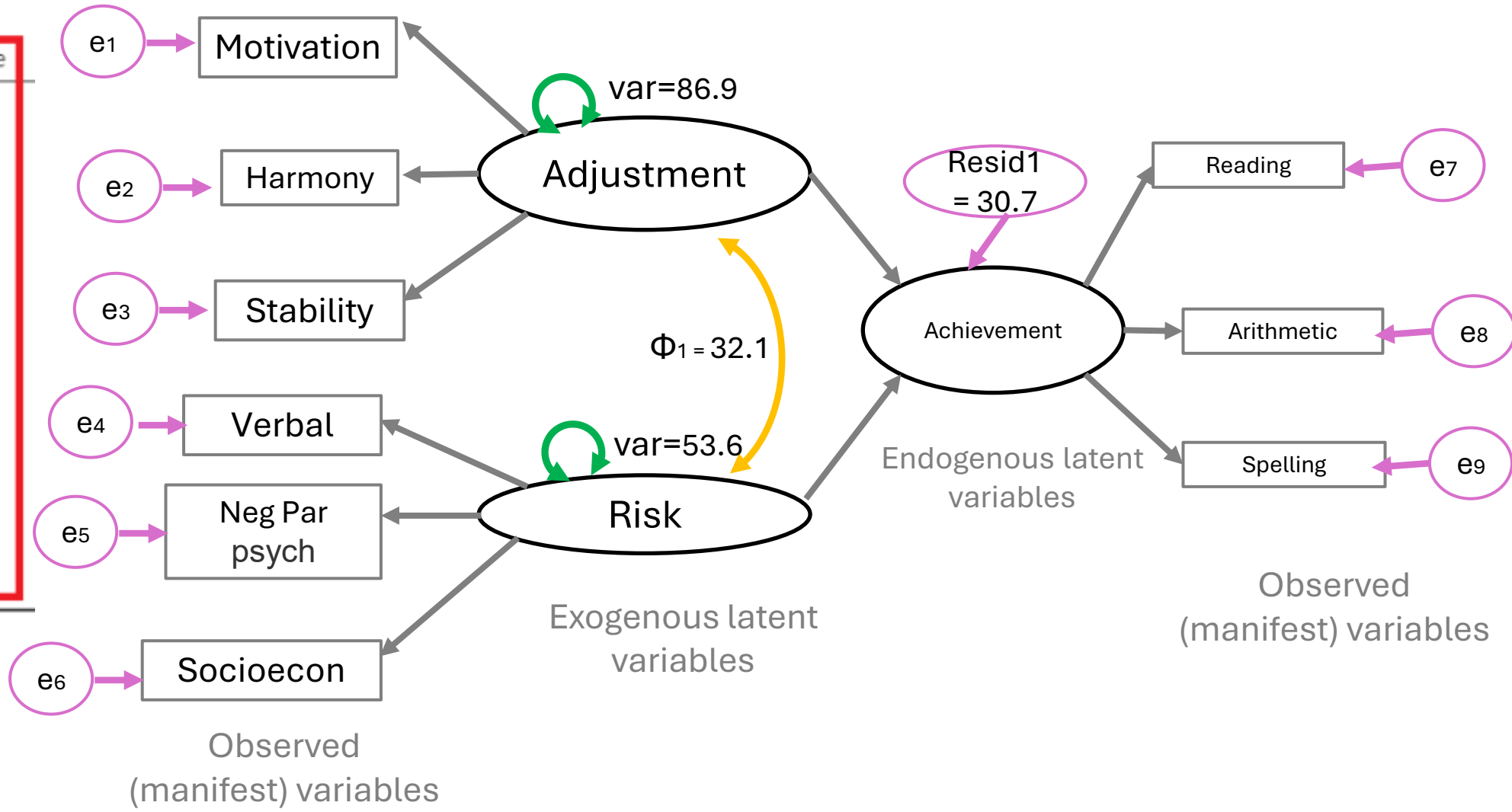
Latent	Observed	Estimate
Adjustment	motiv	1.000
	harm	0.884
	stabi	0.695
Risk	verbal	1.000
	ppsych	−0.770
	ses	0.807
Achievement	read	1.000
	arith	0.837
	spell	0.976



Variances and Covariances

Variances and Covariances

Variable 1	Variable 2	Estimate
motiv	motiv	12.870
harm	harm	31.805
stabi	stabi	57.836
verbal	verbal	46.239
ppsych	ppsych	68.033
ses	ses	64.916
read	read	11.372
arith	arith	37.818
spell	spell	15.560
Adjustment	Adjustment	86.930
Risk	Risk	53.561
Achievement	Achievement	30.685
Adjustment	Risk	32.098



Path diagram