HIGHER ORDER COMPONENT SCORES FOR THE QLQ-C30:

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on behalf of
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Why “higher order” component scores?

- 15 dimensions are unwieldy for clinicians, patients, and researchers
- Reduces complexity of analyses (multiple end-points) and problems with multiple testing
- Frequent requests from users
- The competition is doing it!
- Theory formation –relating 15 dimensions in a meaningful way- may be a way forward.

Extra Requirements: Generalizable Results

- Measurement Equivalence over (patient and language) groups: identical item thresholds, factor structures, and factor loadings

  …essential in order to make comparisons over groups: if equivalence (partially) fails,then some comparisons between groups may not be justifiable…

- Cross Validation

- Predictive Validity

Data

The CCA project has gathered QLQ-C30 data from 38,000 patients in 100+ studies from various:

- countries,
- primary disease sites,
- disease stages, and
- treatment phases.

Data

Split into 4 analysis groups:

- a 10% sample for exploratory purposes
- a 30% sample for model fitting
- a 30% sample for cross validation

and

- a 30% sample for testing of measurement equivalence.

Data

However, only those cancer patients using the QLQ-C30 version 3.0 at “pre-treatment” were utilized, leaving:

2500 patients for model fitting.

Sufficient sample size, even for “robust” estimation methods!

Methods

Confirmatory Factor Analysis (CFA)/
Structural Equation Modeling(SEM)

what is that?

Methods (1)

- CFA/SEM is a general statistical method to model relationships between Observable variables and Non-observable (latent) variables.
- Latent variables are measured/defined by observables, and may incorporate (estimates of) measurement error.
- Latent variables may correlate with, predict or be predicted by other latents or observables.

Methods (2)

- One posits a theoretical model (of latents and observables, and their relationships), which results in fixing some model parameters (possibly to zero) and freeing others. ("model architecture")

- Values of the free parameters are estimated (on the basis of the observed data), minimizing the difference between the model predictions (given a set of specific estimates) and the data. ("model estimation")

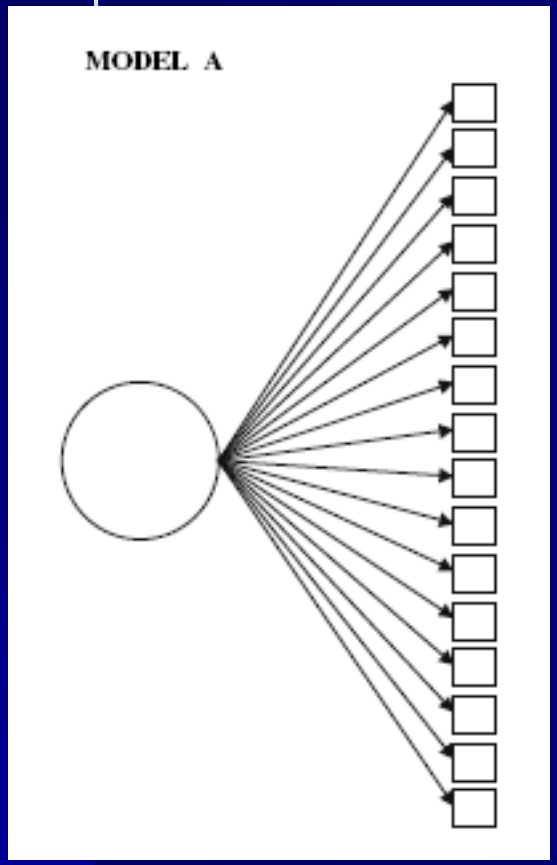
Methods (3)

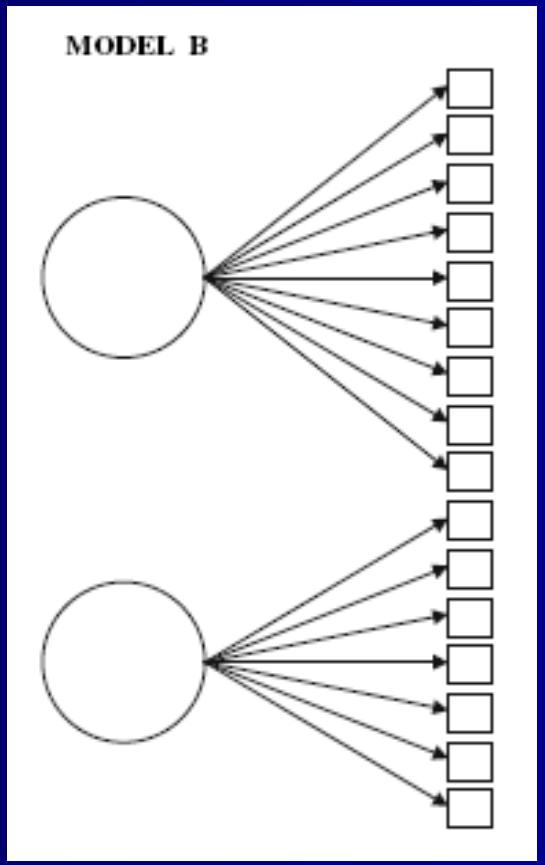
- The model fit (as measured by various indices/tests) is evaluated, and “problems” examined.
- The model may be rejected as insufficient. It may be modified, or it may be accepted as adequate/good.
- If the model is accepted, one may proceed with the model and its parameter estimates.

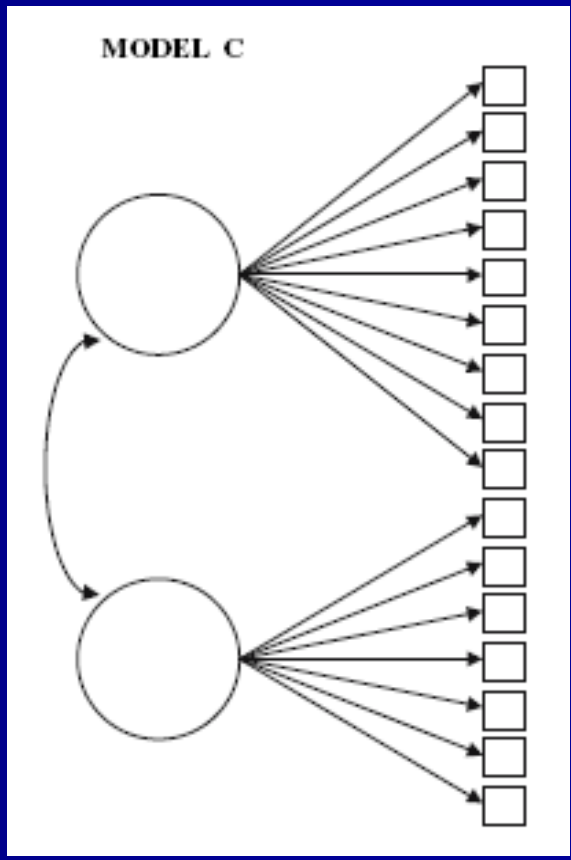
Examples

- Simple CFA models
- Higher Order & Bi-Factor Models
- Reflective and Formative Models
- Multiple Indicators-Multiple Causes (MIMIC) Models
- Hybrid Model

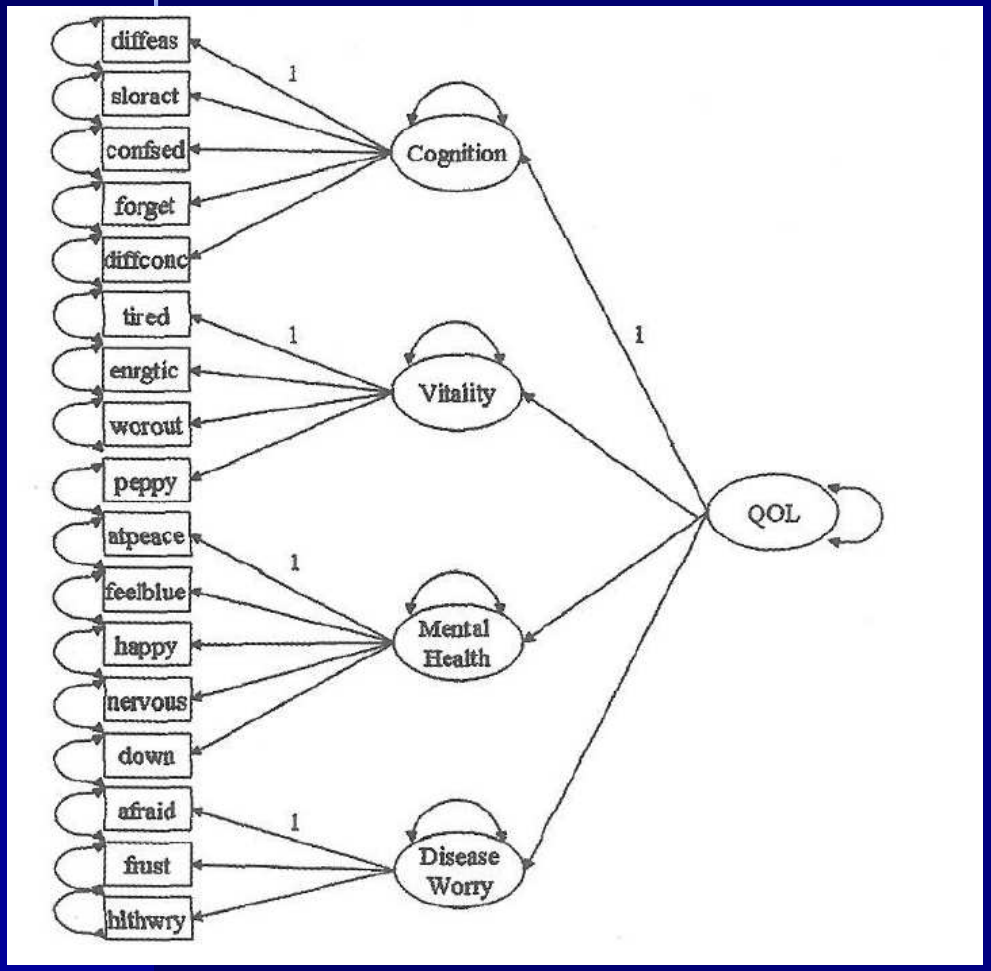
Simple CFA Models

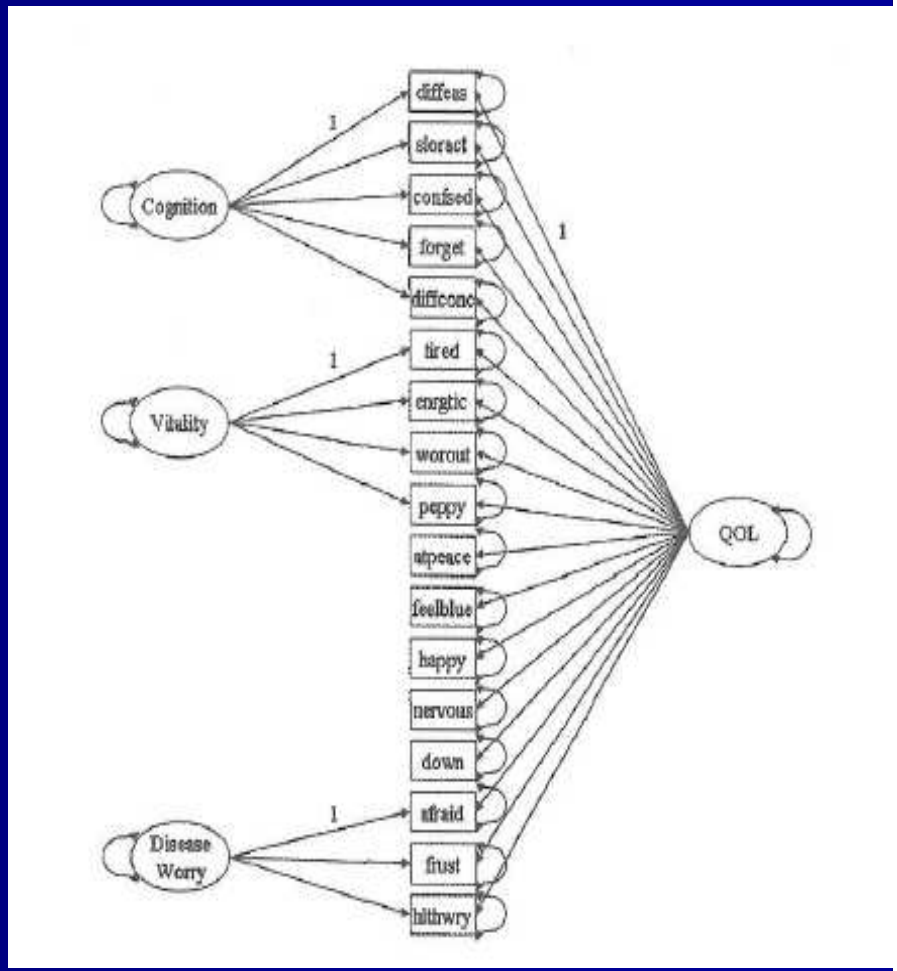




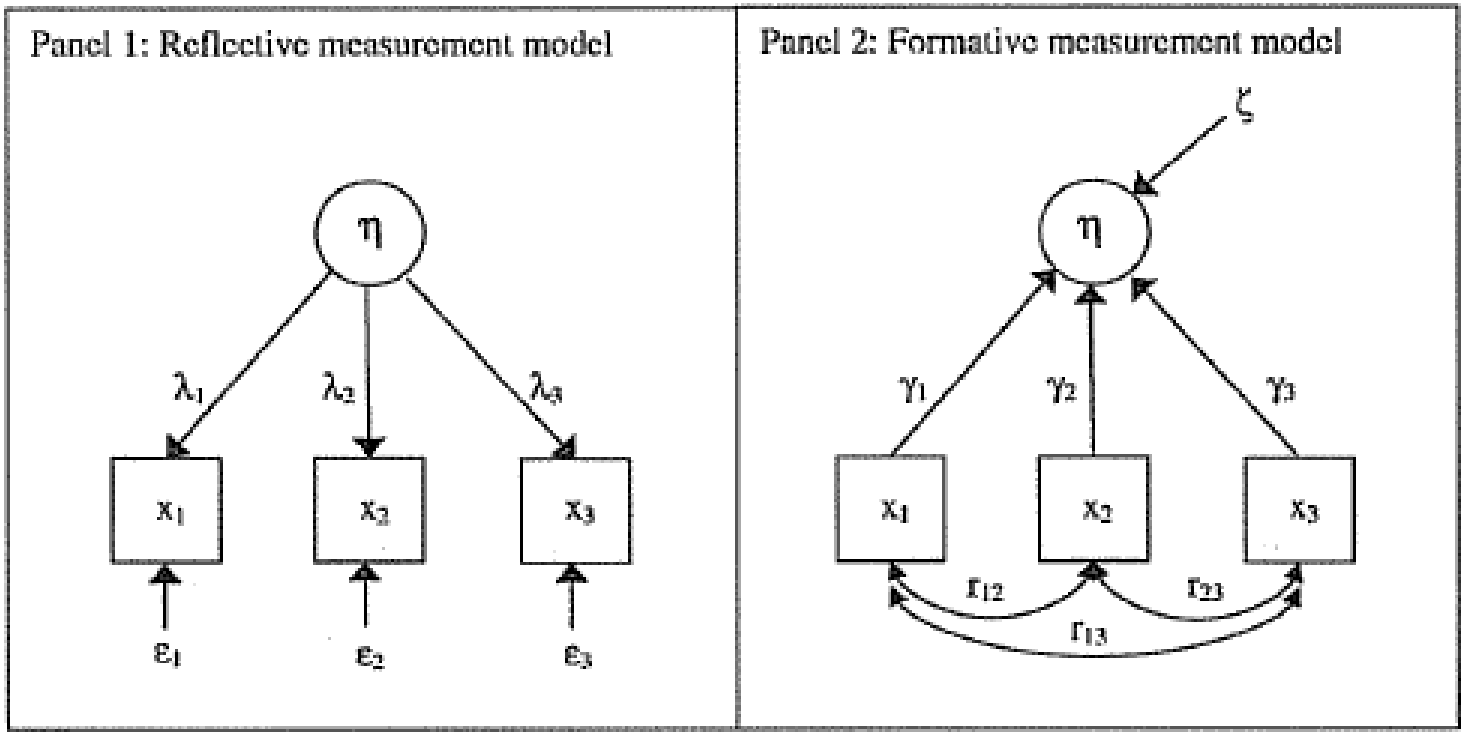


Higher Order & Bi-Factor Models

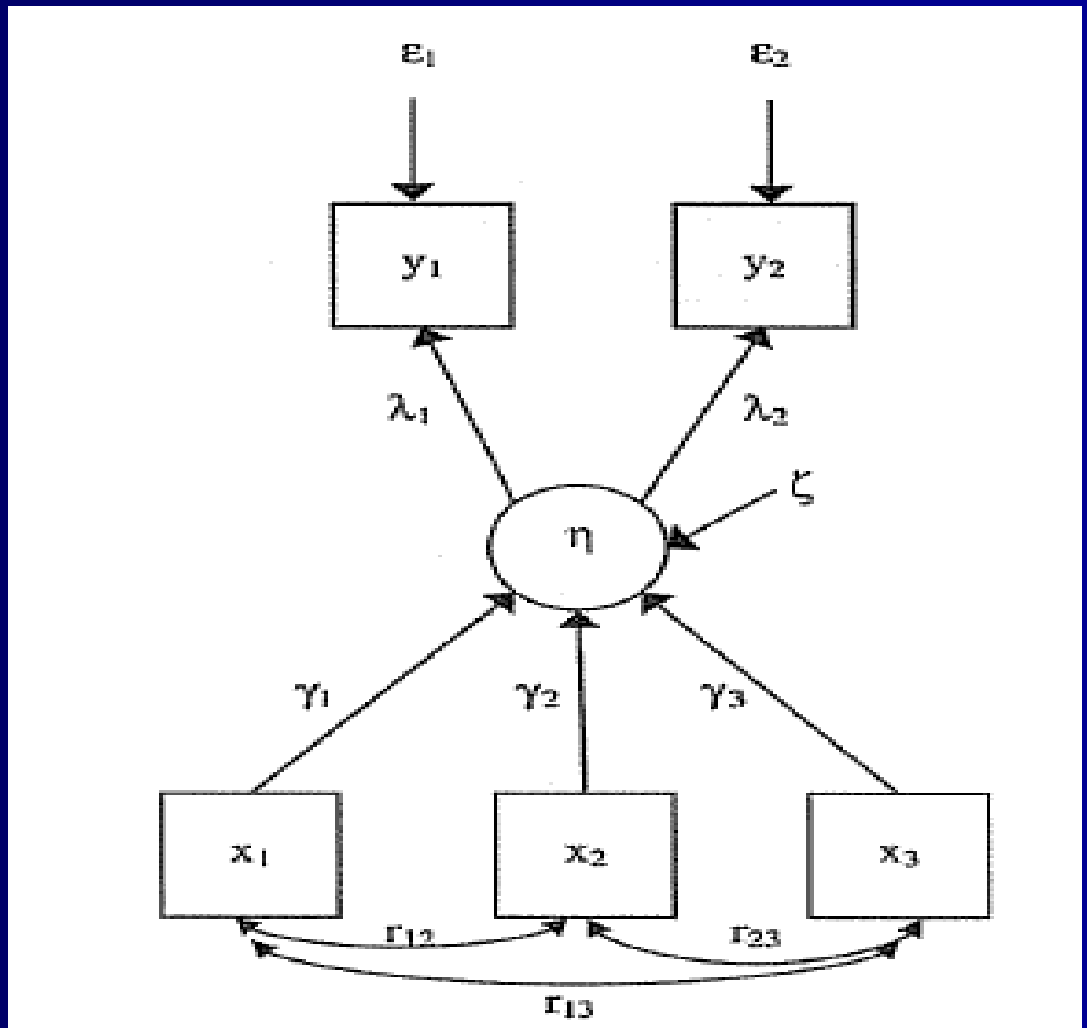




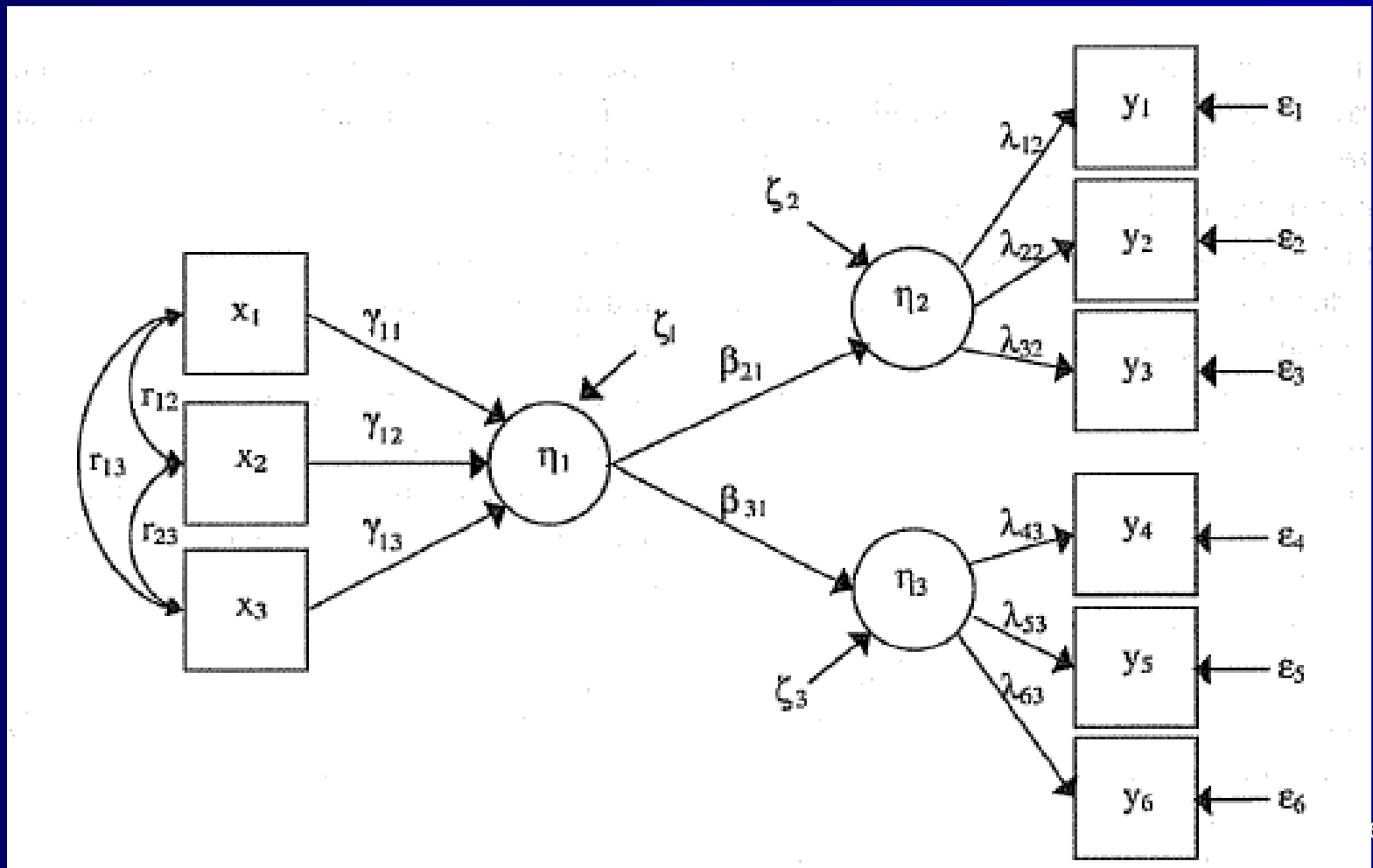
Reflective and Formative Models



Multiple Indicators-Multiple Causes (MIMIC) (SEM) Models



Hybrid Model



Modeling Issues (1)

- QLQ-C30 version 3.0 only
- Pre-treatment/ baseline (initially)
- Include/exclude healthy S's?
- Estimates for single-item scale error variance (test-retest correlations)
- Exclude FI (and QL?) scales
- Standard QLQ-C30 model architecture

Modeling Issues (2)

- "Robust WLSMV" (ADF) estimators (also MLR if possible, for comparing non-nested models)
- Treatment of missing data (pair-wise, FIML)
- Ordinal items (polychoric correlations)
- Correction for clustering
- Formative-reflective symptom modeling

- **Which (theoretical) models?**

Theoretical QLQ-C30 Factor Models (1)

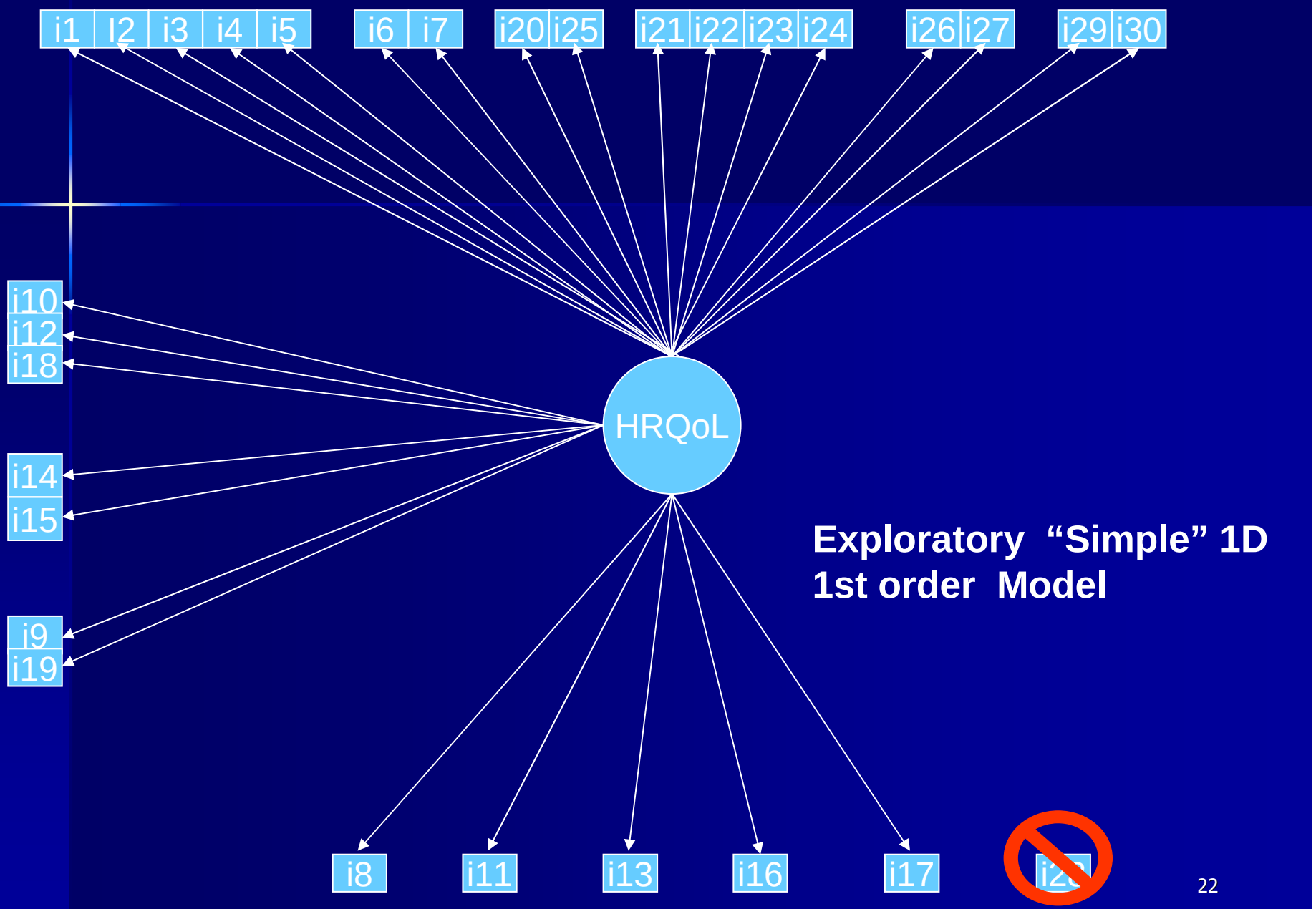
- "standard" QLQ 14D 1st order model
- 1D 2nd order model (e.g., Pagano & Gotay)
- 2D 2nd order model Symptom & Function (formative and/or reflective symptoms)
  (e.g., Sousa et al., Boehmer & Luszczynska)
- 2D 2nd order Burden-Mental Model (pers.comm. NKA)

Theoretical QLQ-C30 Factor Models (2)

- 2D 2nd order Physical-Mental Model (pers.comm. MS)
- Multiple Indicators-Multiple Causes (MIMIC) Models
- Bi-Factor models (relaxed or completely orthogonal)

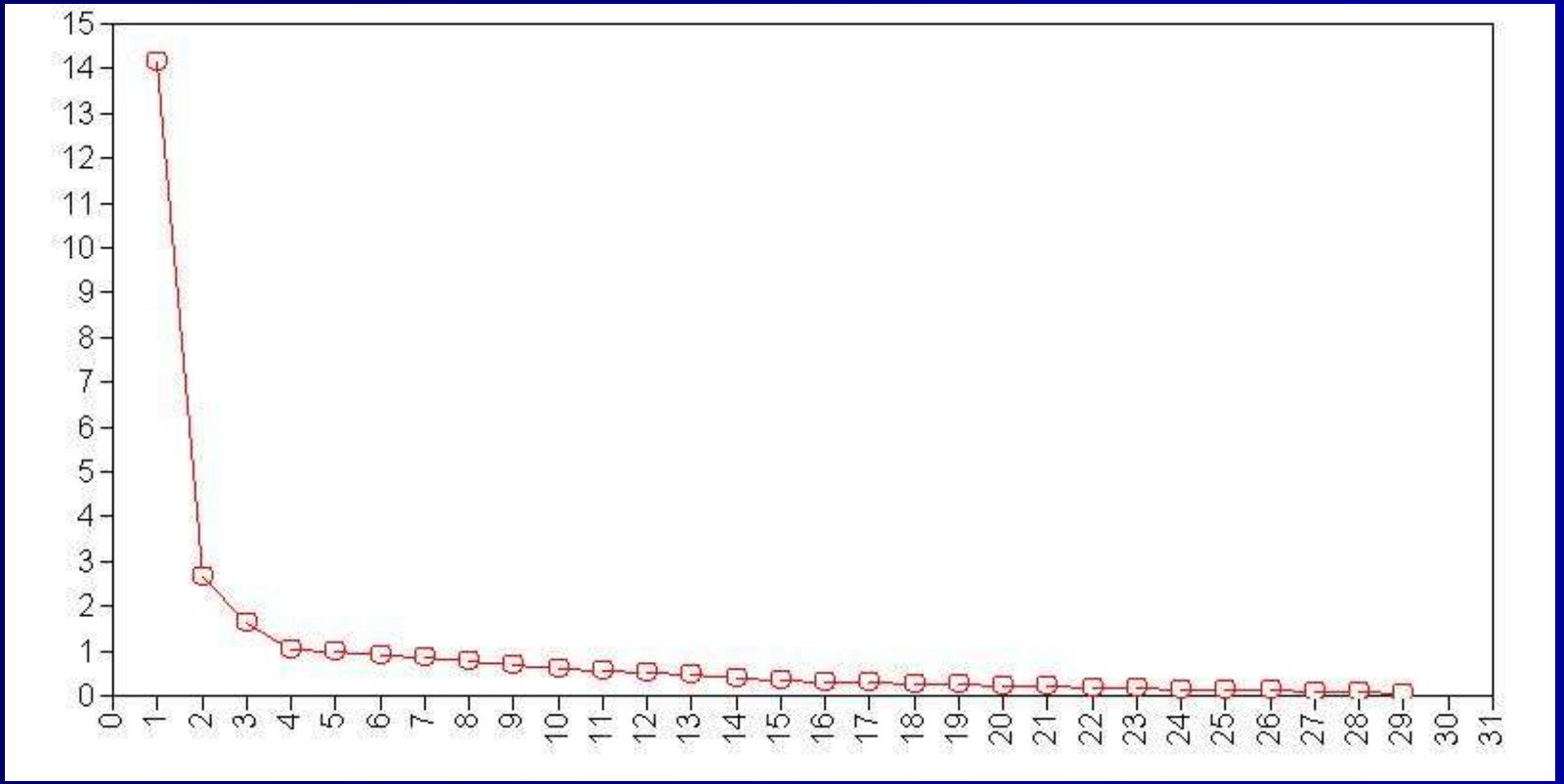
RESULTS

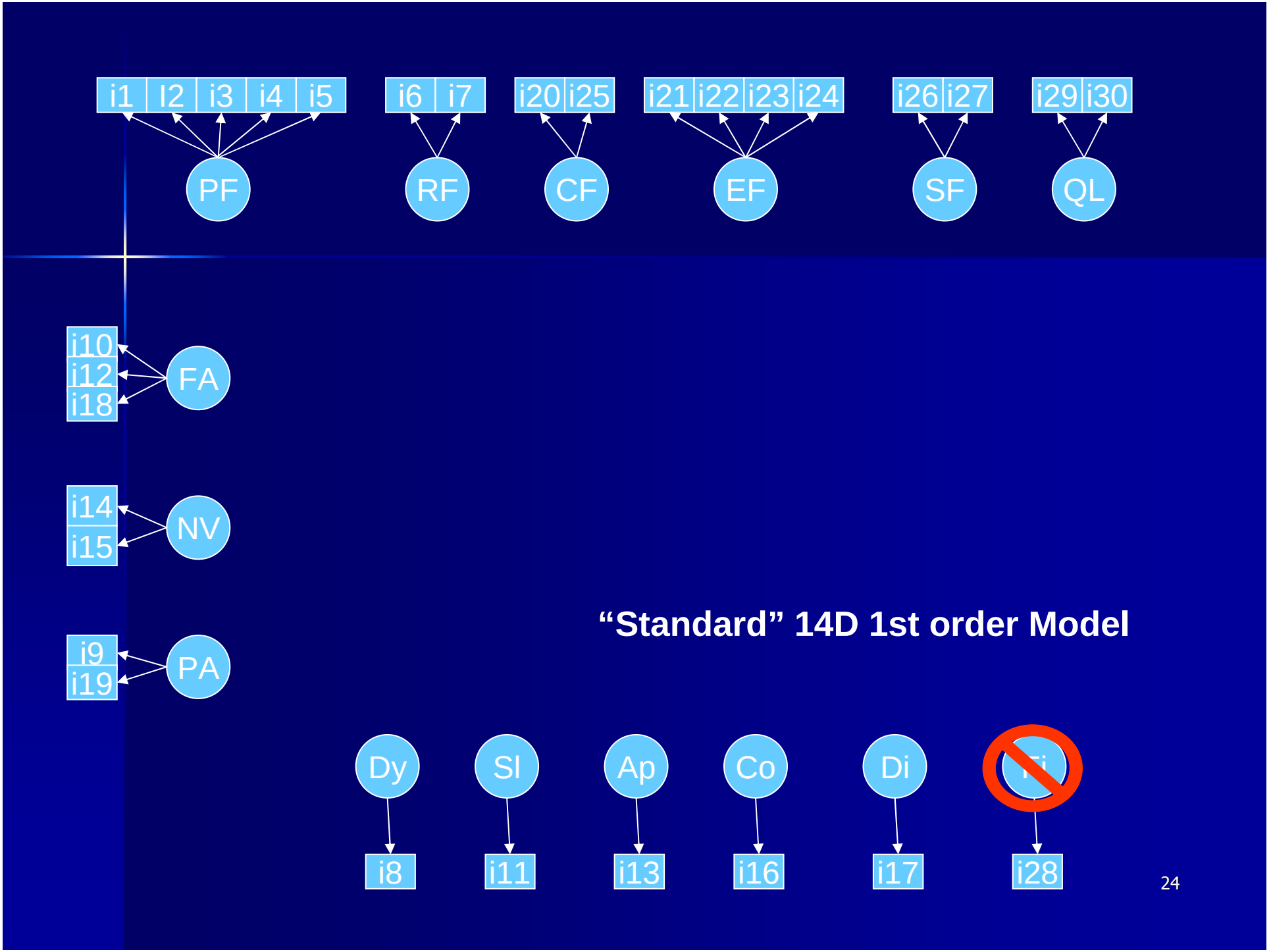
Simple 1D First Order HRQoL (e.g., Pagano & Gotay, 2006)



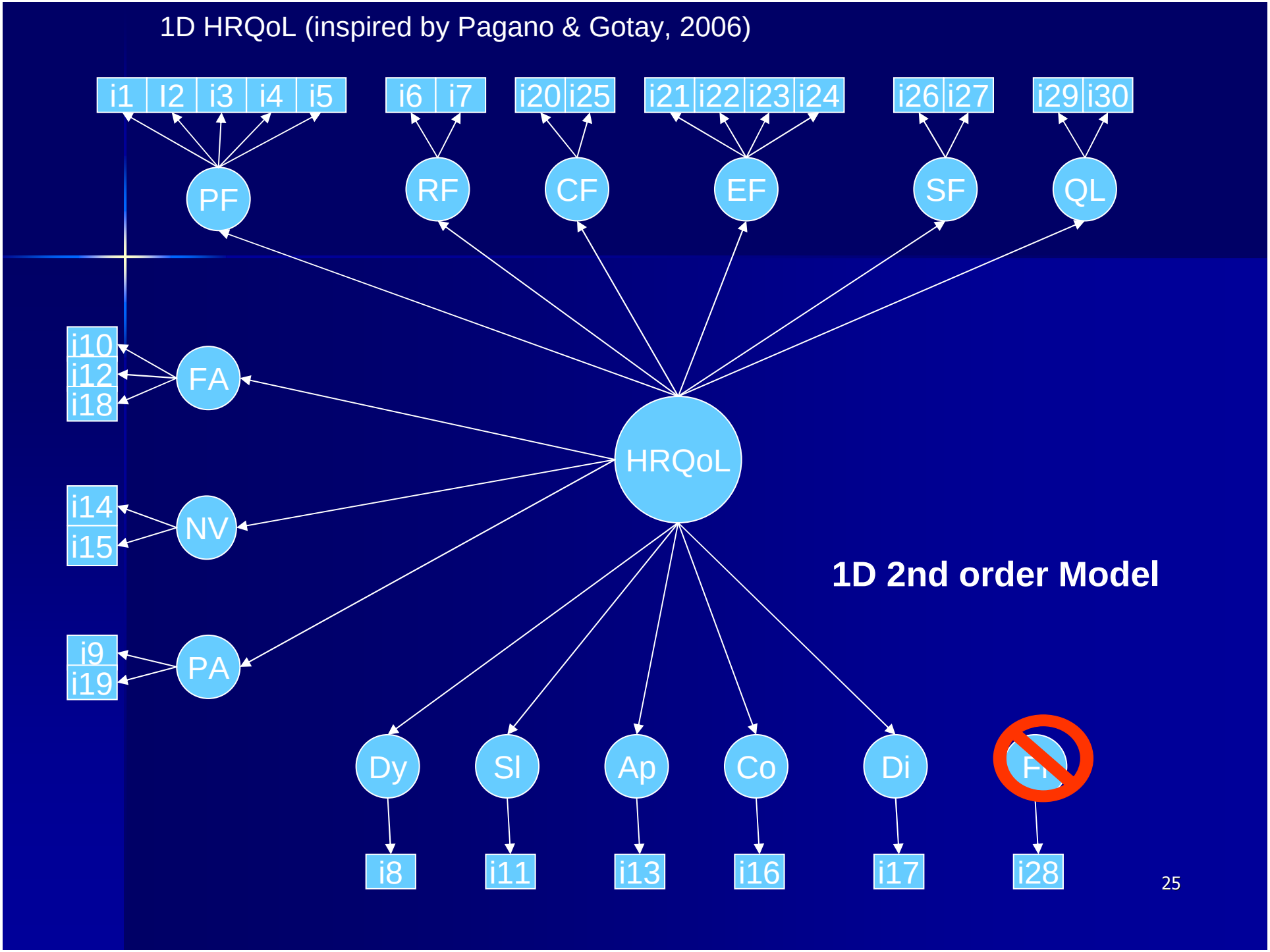
Exploratory "Simple" 1D 1st order Model

"Explained" Variance
(eigenvalues) per factor in EFA for 29 QLQ-C30 items ("scree plot")

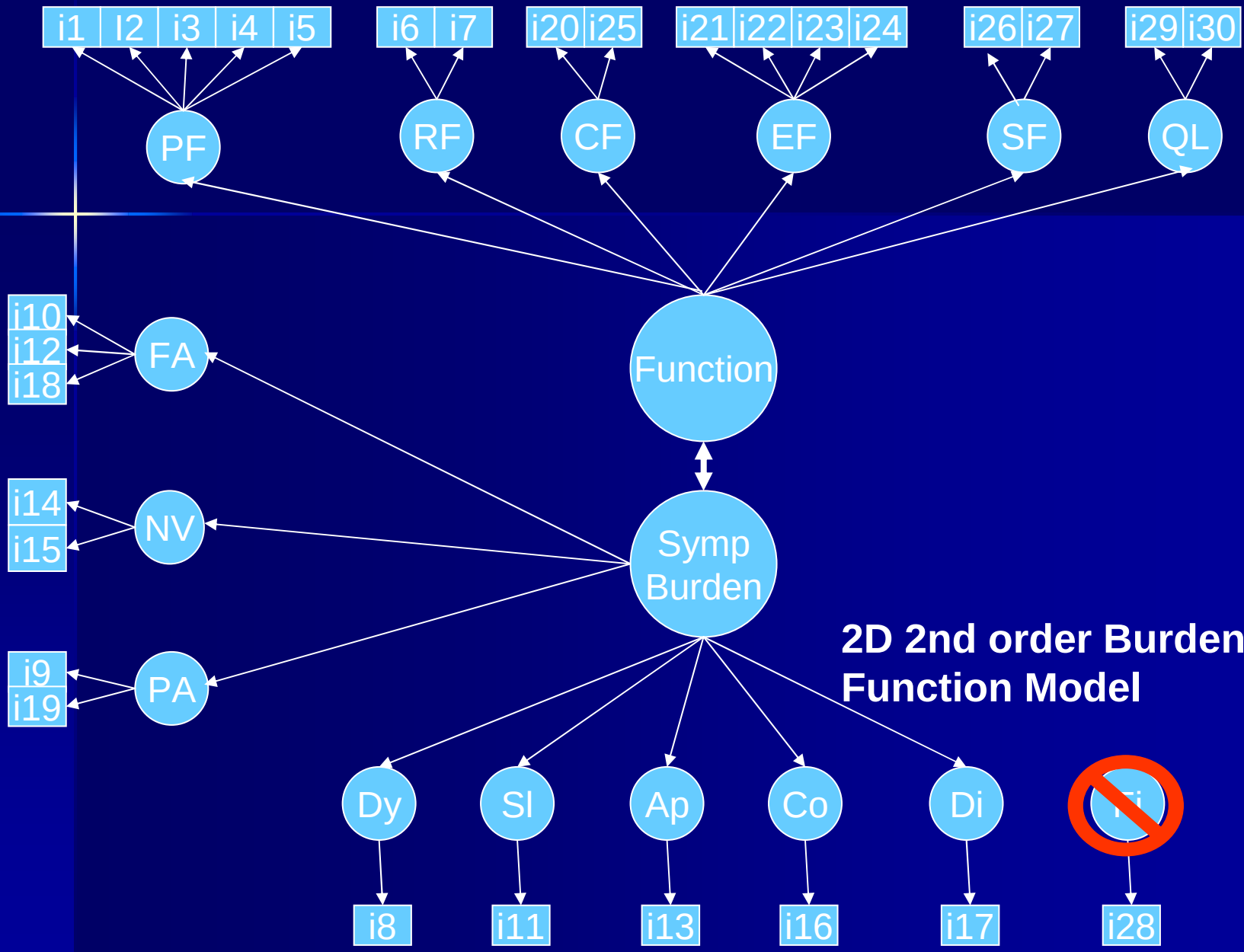




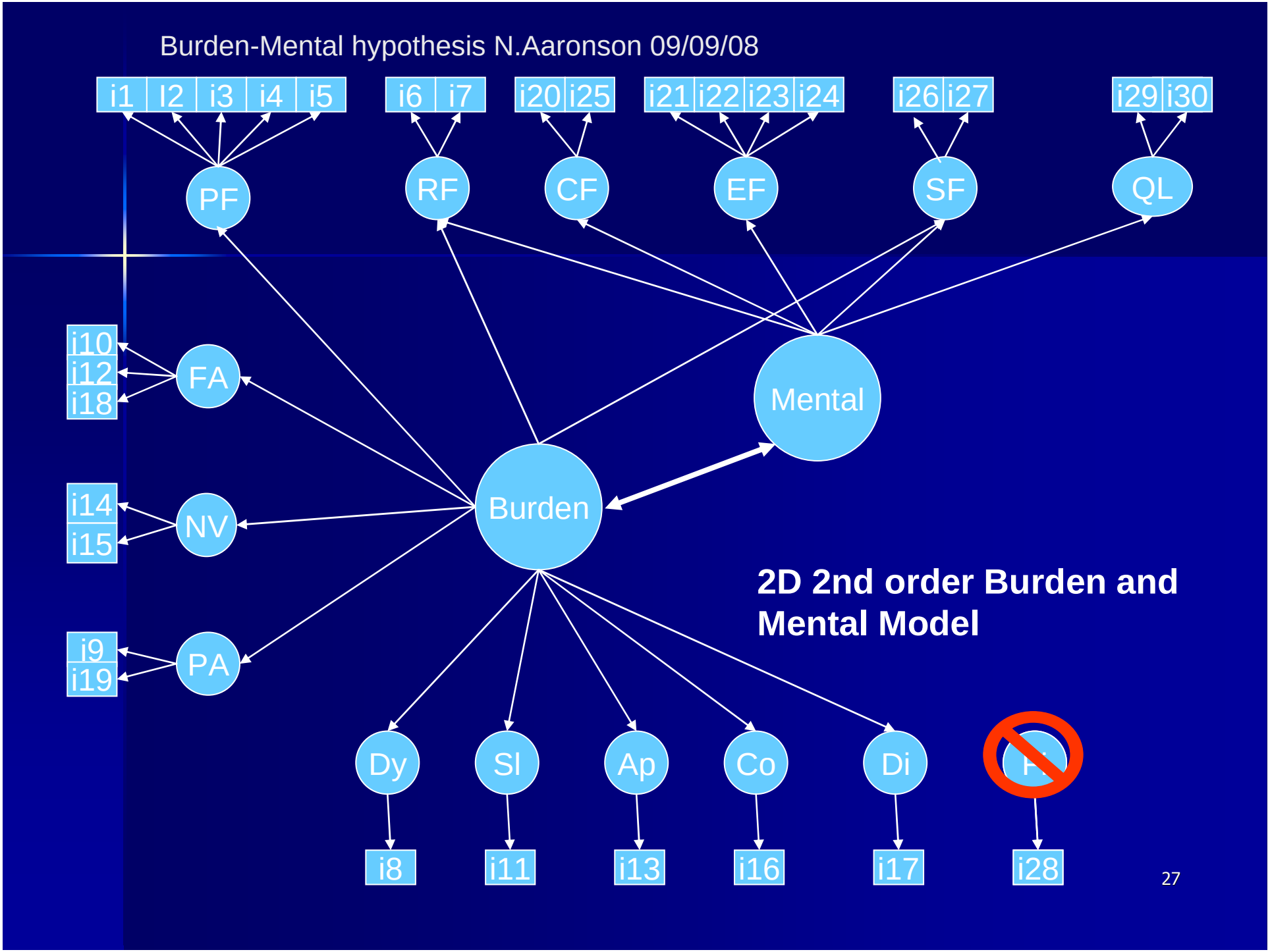
“Standard” 14D 1st order Model

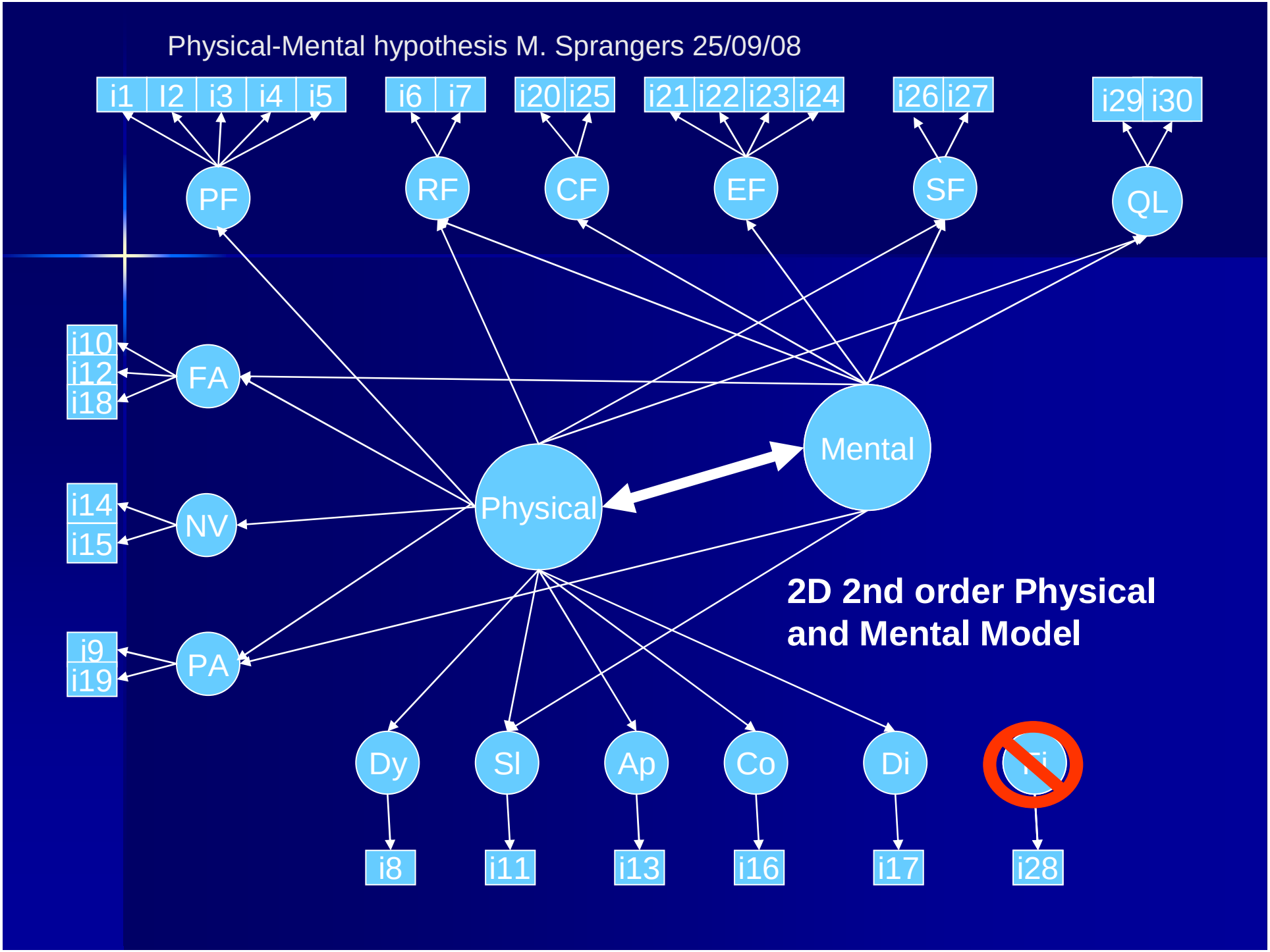

1D HRQoL (inspired by Pagano & Gotay, 2006)
i1 I2 i3 i4 i5
i6 i7
i20 i25
i21 i22 i23 i24
i26 i27
i29 i30
PF
RF
CF
EF
SF
QL
i10
i12
i18
FA
HRQoL
i14
i15
NV
i9
i19
PA
Dy
Sl
Ap
Co
Di
i8
i11
i13
i16
i17
i28
1D 2nd order Model

Burden-Function (inspired by Sousa & Kwok, 2006, Putting Wilson and Cleary to the test)



2D 2nd order Burden & Function Model


Burden-Mental hypothesis N.Aaronson 09/09/08
i1 I2 i3 i4 i5
i6 i7
i20 i25
i21 i22 i23 i24
i26 i27
i29 i30
PF
RF
CF
EF
SF
QL
i10
i12
i18
FA
Mental
i14
i15
NV
Burden
i9
i19
PA
2D 2nd order Burden and Mental Model
Dy
Sl
Ap
Co
Di
i8
i11
i13
i16
i17
i28


Physical-Mental hypothesis M. Sprangers 25/09/08
i1 I2 i3 i4 i5
i6 i7
i20 i25
i21 i22 i23 i24
i26 i27
i29 i30
PF
RF
CF
EF
SF
QL
i10
i12
i18
FA
i14
i15
NV
i9
i19
PA
Physical
Mental
2D 2nd order Physical and Mental Model
Dy
Sl
Ap
Co
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i8
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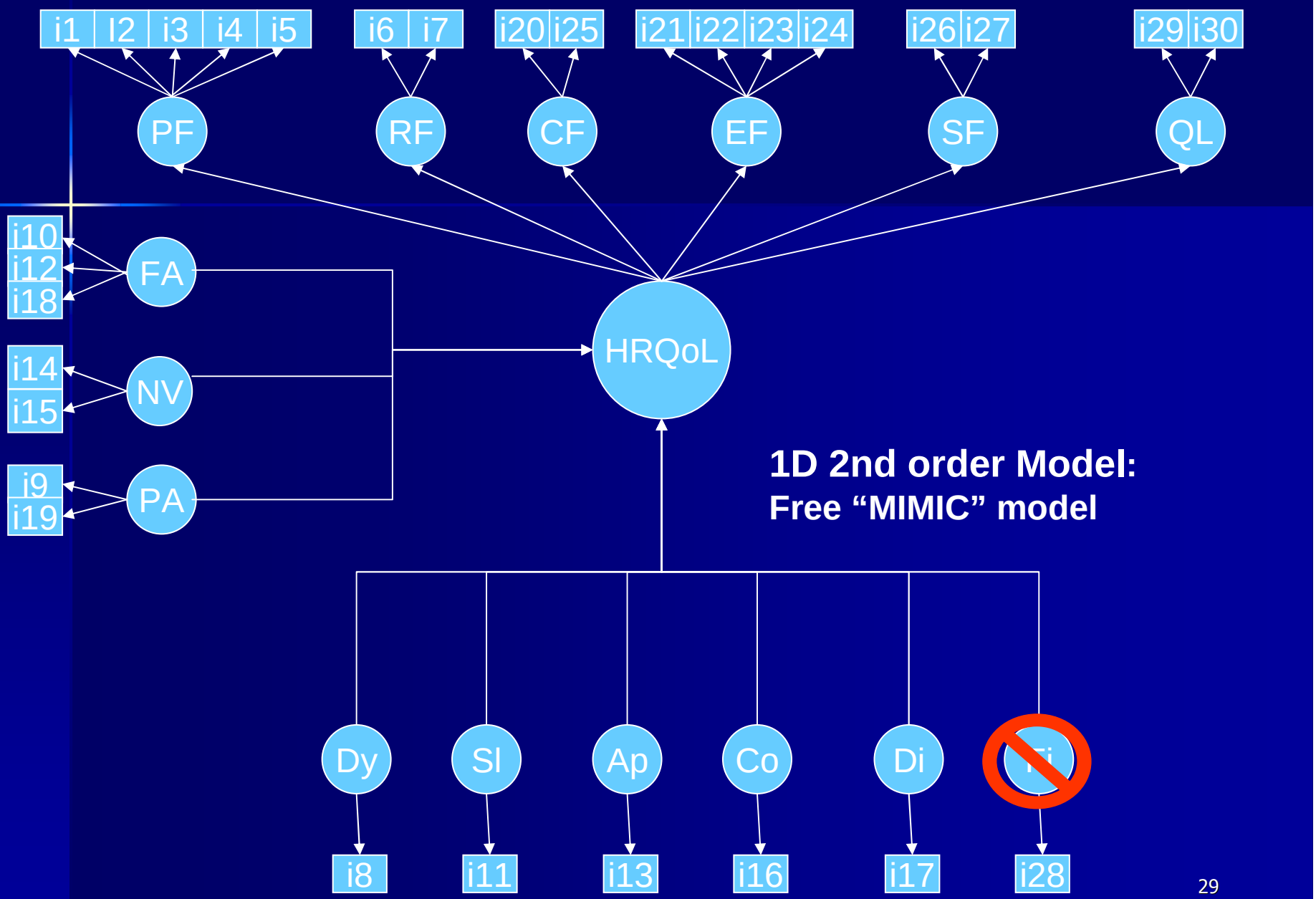
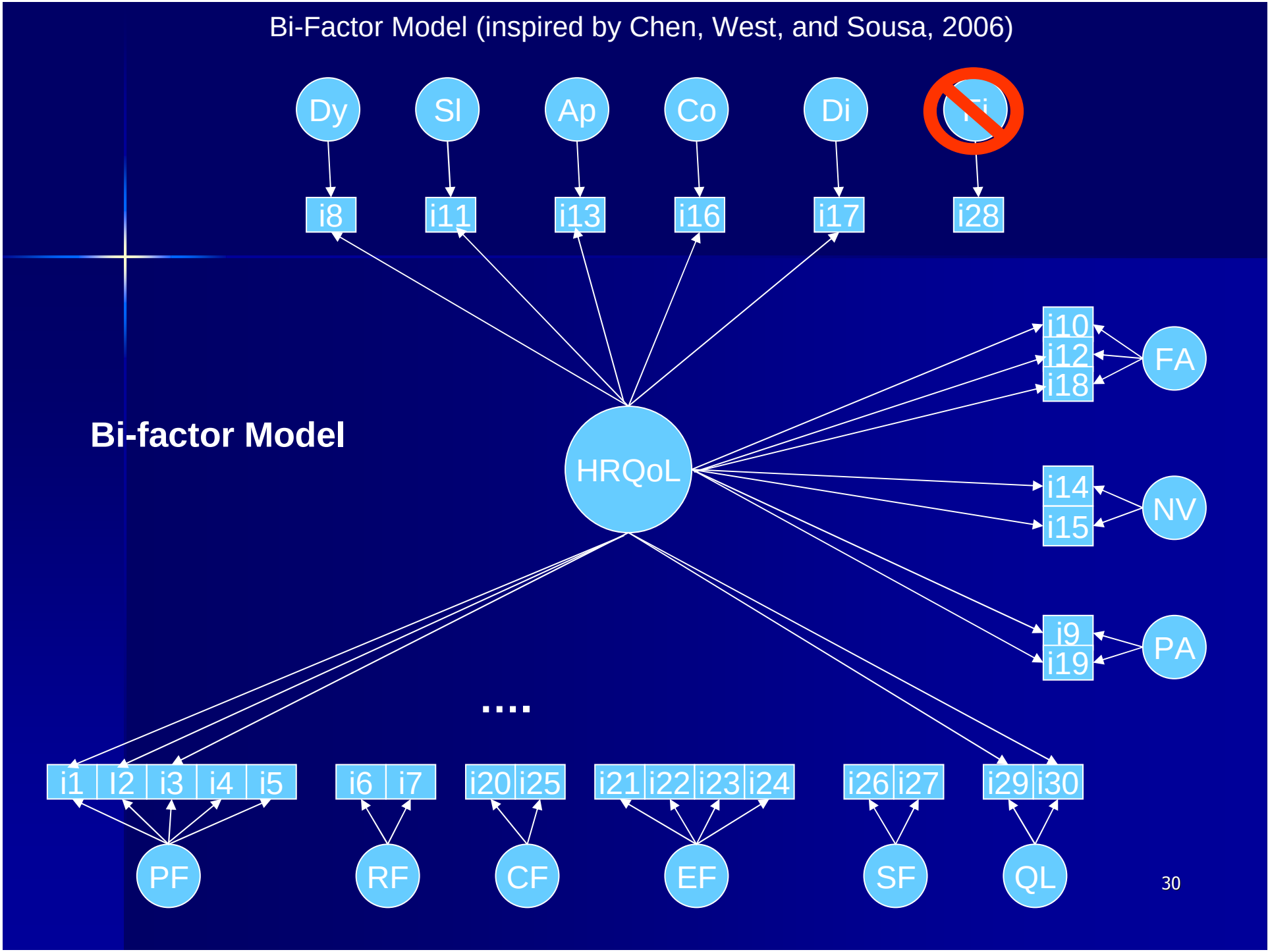
i13
i16
i17
i28

Free MIMIC (inspired by Boehmer & Luszczynska, 2006)




Bi-Factor Model (inspired by Chen, West, and Sousa, 2006)
Dy
Sl
Ap
Co
Di
Fi
i8
i11
i13
i16
i17
i28
Bi-factor Model
HRQoL
i10
i12
i18
FA
i14
i15
NV
i9
i19
PA
....
i1
I2
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i4
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i21
i22
i23
i24
i26
i27
i29
i30
PF
RF
CF
EF
SF
QL

Fit Indices/Tests for Various Models*

Model	χ^2	df	CFI/TLI	RMSEA	Remarks
1) **Basic Model with 14 Latents**	109	12	0.93/0.98	0.047	Ordinal items; 1-item scale error variances based on test-retest correlations
2) 1D Burden	208	14	0.89/0.97	0.058	
3) 2D Burden & Function	208	14	0.89/0.97	0.058	Correlation B&F= 0.97
4) 2D Physical & Mental (MS)	167	15	0.91/0.98	0.049	Correlation P&M=0.72
5) 2D Burden & Mental (NKA)	192	14	0.90/0.97	0.055	Correlation B&M=0.92
6) 1D MIMIC (free)	190	13	0.90/0.97	0.057	Correlation FA&HRQoL=0.95
7) 1D MIMIC (fixed)	npd	--	--	--	no solution could be found
8) 2D formative Burden,Function free	187	13	0.90/0.97	0.057	Correlation B&F=0.97
9) 2D formative Burden,Function fixed	204	13	0.89/0.97	0.060	Correlation B&F=0.9
10) 1D (relaxed) Bi-factor	83	16	0.96/0.99	0.032	Correlation "Bi-factor" and other factors set to zero

***WLSMV estimator**

Discussion/Conclusions

- Exploratory Factor Analysis show important 1st dimension, yet requires extra dimensions for “good” fit.
- “Basic Model” has “adequate-good” fit.
- Model fit for all “higher order” models is “adequate”, yet clearly poorer than basic model.

Discussion/Conclusions

- None of the higher order models is substantially superior, wrt “fit”. Multiple dimensions tend to correlate quite highly!
- (Relaxed) bi-factor model has best fit of all!
- However, statistics are not the only criterium for model selection. (e.g., parisimony, usability, compabitibility with other schemes, …)

Alternatives

- **1D 2nd order Model**: parsimonious, fit is "adequate", "summarizes" QLQ-C30 dimensions

- **2D 2nd order Mental-Physical Model**: relatively simple, "summarizes" QLQ-C30, fit is somewhat better than other 2nd order models, dimensions are more distinct, similar rationale to SF-36 higher order model

Alternatives

- **(relaxed) Bi-Factor Model:** “good fit”, parsimonious (latents) , “in additon to” QLQ-C30 dimensions, skirts reflective-formative problem.

- **MIMIC Model**: adequate fit, parsimonious, combines relefective and formative models; has (some) support in literature.

Request

- Data set with external criteria (e.g. in trial or longitudinal study)

and

- QLQ-C30

for validation study.

Suggestions?

Remarks?