

**Confirmatory Factor Analysis of  
Preschool Child Behavior Checklist  
(CBCL) (1.5 – 5 yrs.) among  
Canadian children**

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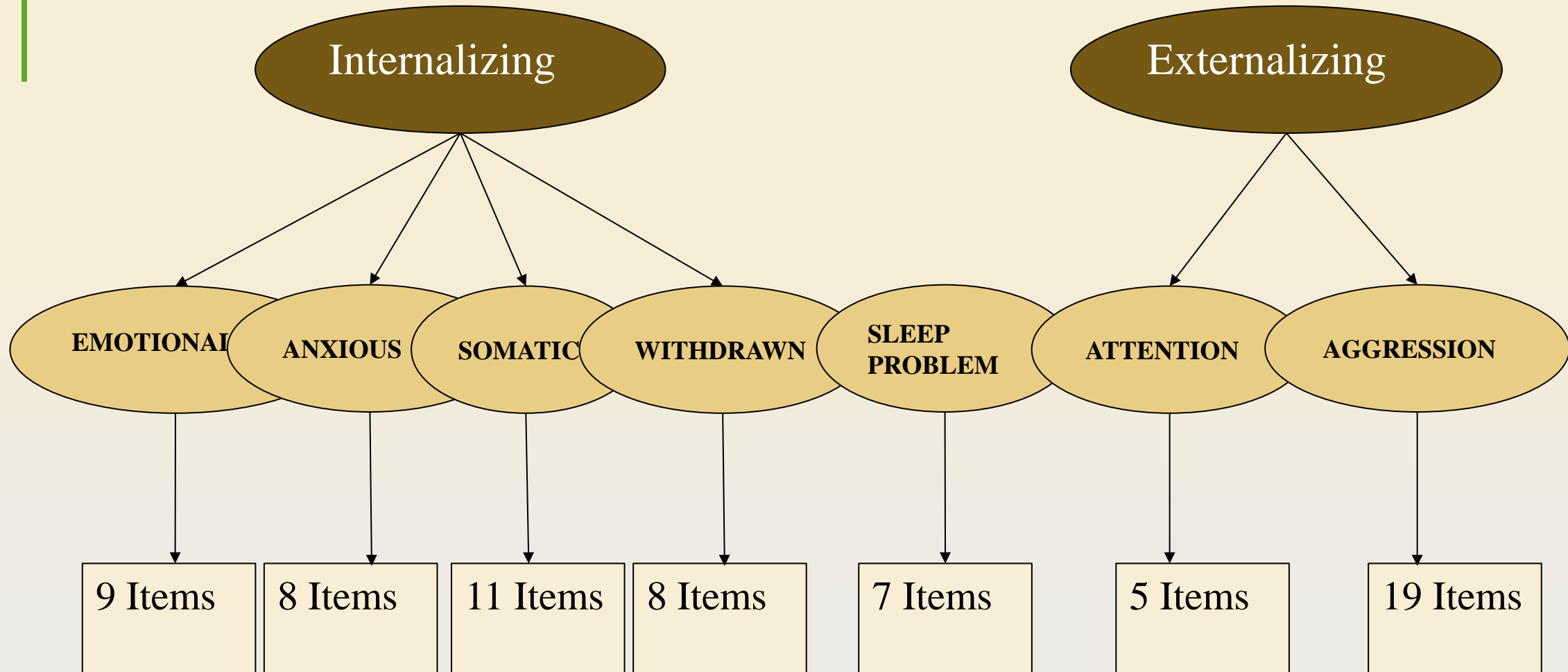
**No conflict of interest**

## Child Behavioural Check List (CBCL) 1.5 – 5 years

- CBCL (1.5 – 5 yrs.) is used to assess the emotional and behavioral development of preschool children.
- It contains two 2<sup>nd</sup> order and seven 1<sup>st</sup> order latent variables derived through factor analysis.
- Designed and normed under the broad umbrella of Classical Test Theory (CTT)
- Test scores from all items are summed up.
  - There is no regard to how the individual item was answered.

# Child Behavioural Check List (CBCL) – 67 item scale

Remaining 23 items are labelled as others



# Child Behavioural Check List (CBCL) 1.5 – 5 years

Item Response options:

0 – “Not true”

1 – “Somewhat or Sometimes True”

2 – “Very True or Often True”

Questions are answered by primary caregiver, mostly mother

Thus, total scores can range between 0 – 200.

# Rationale for the study

- Large longitudinal studies are difficult and few
  - Configural invariance is difficult to establish for scales the size of CBCL
  - Konold et al. (2003) from mothers of typical American two year olds concluded that the original model structure fits the data poorly (N=1097).
  - Tan et al. supported the seven-syndrome model for adopted Chinese American girls (N=907).
- Lack of literature on the invariance among Canadian children.

To examine the number of underlying dimensions of the CBCL and the pattern of item-factor relationship among Canadian preschoolers.

# Confirmatory Factor Analysis (CFA)

- CFA - Factor analysis of continuous observed variables and continuous latent variables using full information maximum likelihood function.
- IFA (Item Factor Analysis) - Analysis of ordered categorical (ordinal, likert scale) observed variables and continuous latent variables using limited information methods.
- To confirm hypothesized factor structure and obtain estimates for each parameter of the measurement model.
  - To measure the reliability (accuracy and precision) of the model.
  - To report the item difficulty parameters of the individual syndromes.

## Methods

- Sample size – responses from mothers of 343 three year olds
- Software – Mplus 7.2, SPSS 22.1
- 14 missing data points
  - Manual imputations with median values using all the remaining data.
- Initial removal of items with high kurtosis scores
  - Resolved the issue of empty cells and highly negative correlations between pairs of items
- **Robust weighted least squares estimator (WLSMV) with polychoric correlations and delta parameterization.**



# Methods

- Two phase analysis:
  - Evaluate the fit of the first order individual behaviour syndromes
  - Build the higher order model based on the correlation structure of the latent factors
  - Compare the model fit with chi-square test of difference ('Difftest')

## Assessing Model Fit

- Items to be retained as a potential candidate:
  - Factor loadings must be significant ( $p < 0.05$ )
  - Standardized loadings exceeded 0.2
  - Sign of the loadings was positive

# Fit indices

- **Weighted root mean square residual (WRMR) -  $>0.9$** 
  - Evaluates the hypothesis that observed and predicted matrices match
- **Root mean square error of approximation (RMSEA) -  $<0.05$** 
  - Assesses the extent to which a model fits reasonably well in the population
- **Comparative fit index (CFI) -  $>0.95$**
- **Tucker Lewis Index (TLI) -  $>0.95$**
- **Reliability measures**
  - **Information curves (ICs) – used to compute reliability of the subscale**
    - Information/information +1
    - For test information of 4, indicates reliability of 0.8

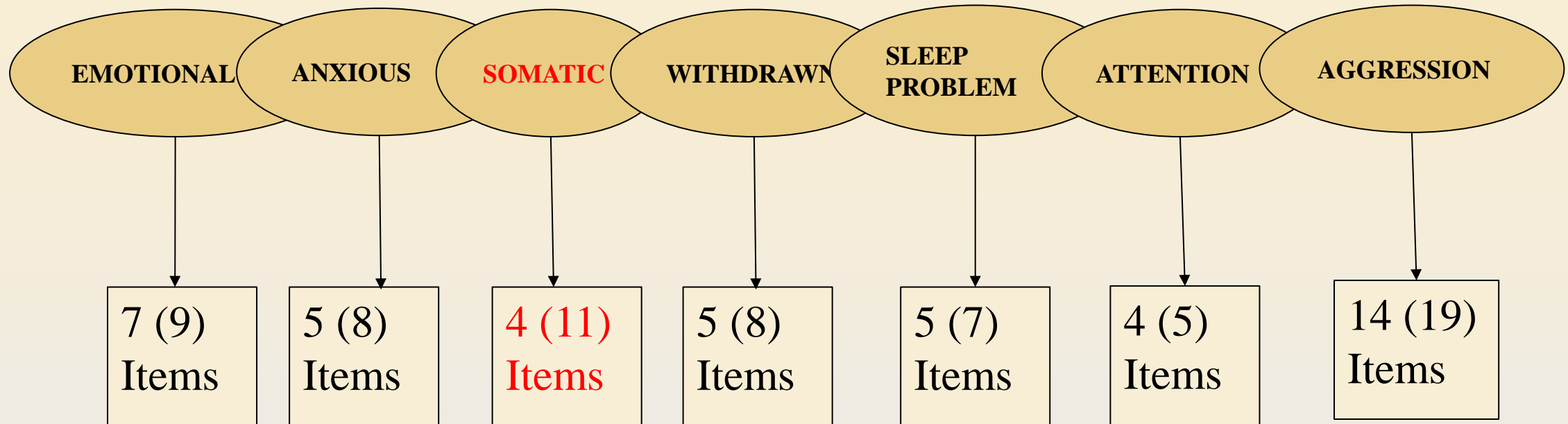
## Results

- Mean age of  $36.6 \pm 3.8$  months
- Approximately, 52.5% were girls
- Most, 94.5% were reported to be in excellent health
- For most children (87.5%), both parents were Caucasian

# Model fit parameters for individual syndromes in the CBCL

Model	RMSEA	CFI	TLI	WRMR
Anxiety	0.04 (0.0 – 0.1)	0.99	0.97	0.56
Emotionally reactive	0.04 (0.0 – 0.07)	0.98	0.97	0.64
<b>Somatic problems</b>	<b>0.11 (0.05 – 0.2)</b>	<b>0.68</b>	<b>0.04</b>	<b>0.9</b>
Withdrawn behaviour	0.06 (0.01 – 0.1)	0.99	0.98	0.6
Sleep problems	0.05 (0.0 – 0.1)	0.99	0.97	0.5
Aggressive behaviour	0.05 (0.04 – 0.06)	0.97	0.96	0.92
Attention problems	0.00 (0.0 – 0.4)	1.00	1.01	0.07

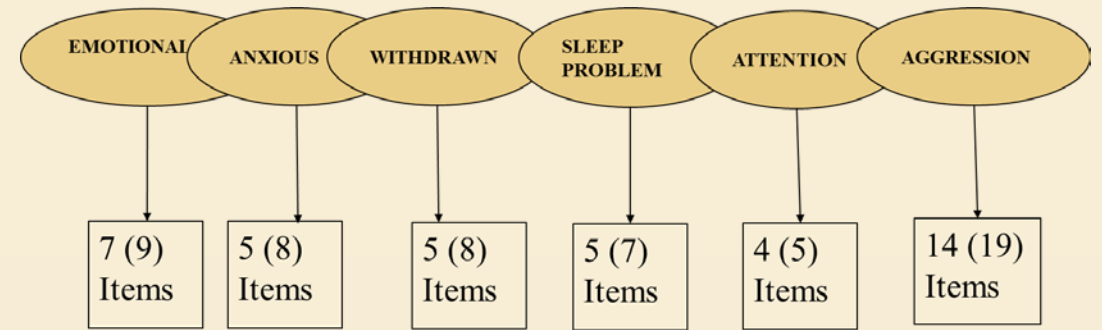
# Child Behavioural Check List (CBCL)



# 1<sup>st</sup> order correlated model with six subscales

- **Did not converge**

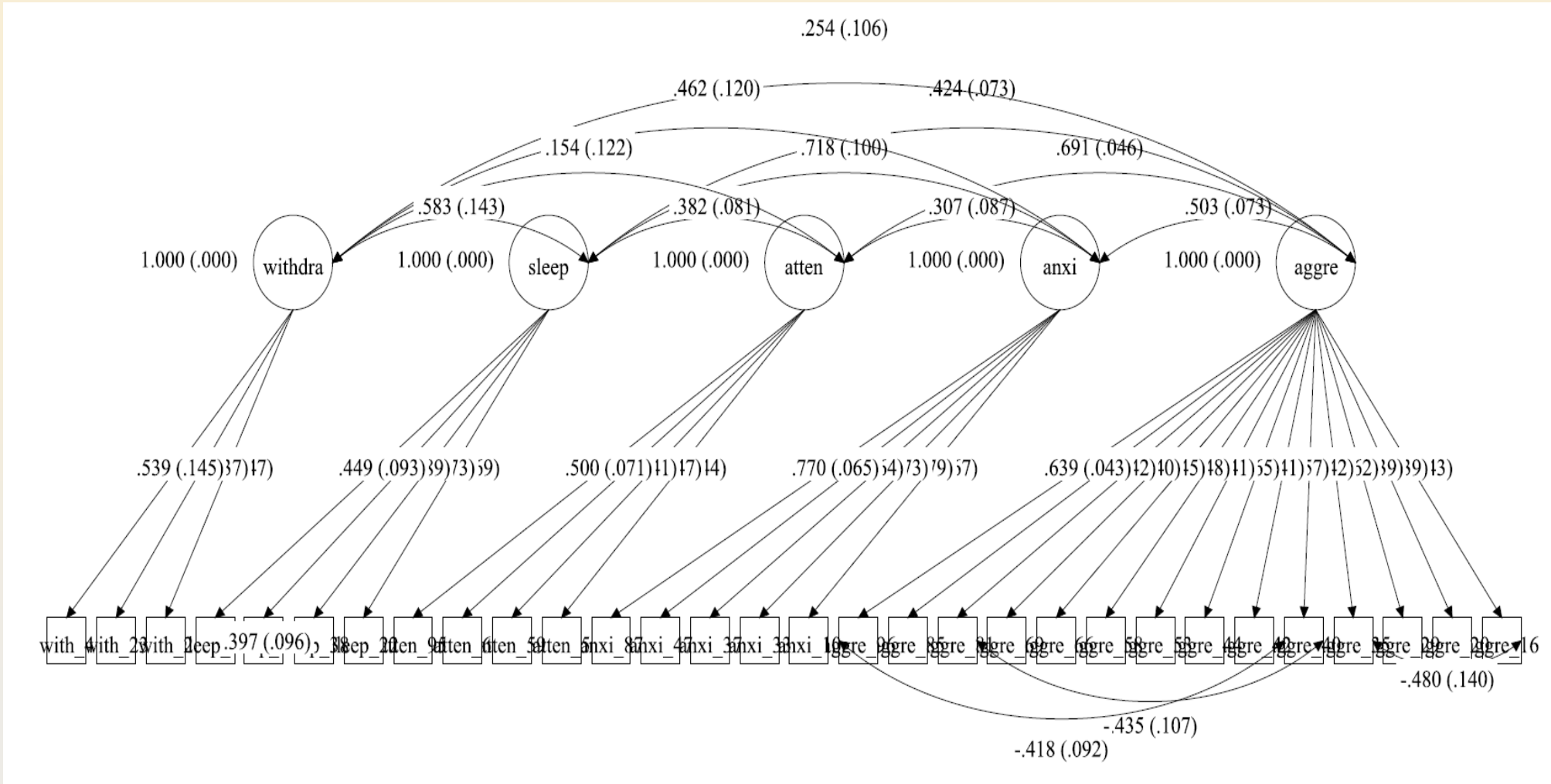
- Anxious and emotionally reactive
  - Correlation coefficient of 1.06
  - Negative residual variance
  - Commonly known as: **Heywood case**



- Items in emotionally reactive subscale were also highly correlated with the aggressive behaviour and attention problems.
- Heywood case could not be corrected through parameter fixation or setting the negative variance to zero.
- Hence, emotionally reactive was also removed from further analysis.

# 1<sup>st</sup> order correlated model: with five subscales

RMSEA = 0.03 CFI = 0.96 TLI = 0.96 WRMR = 0.95





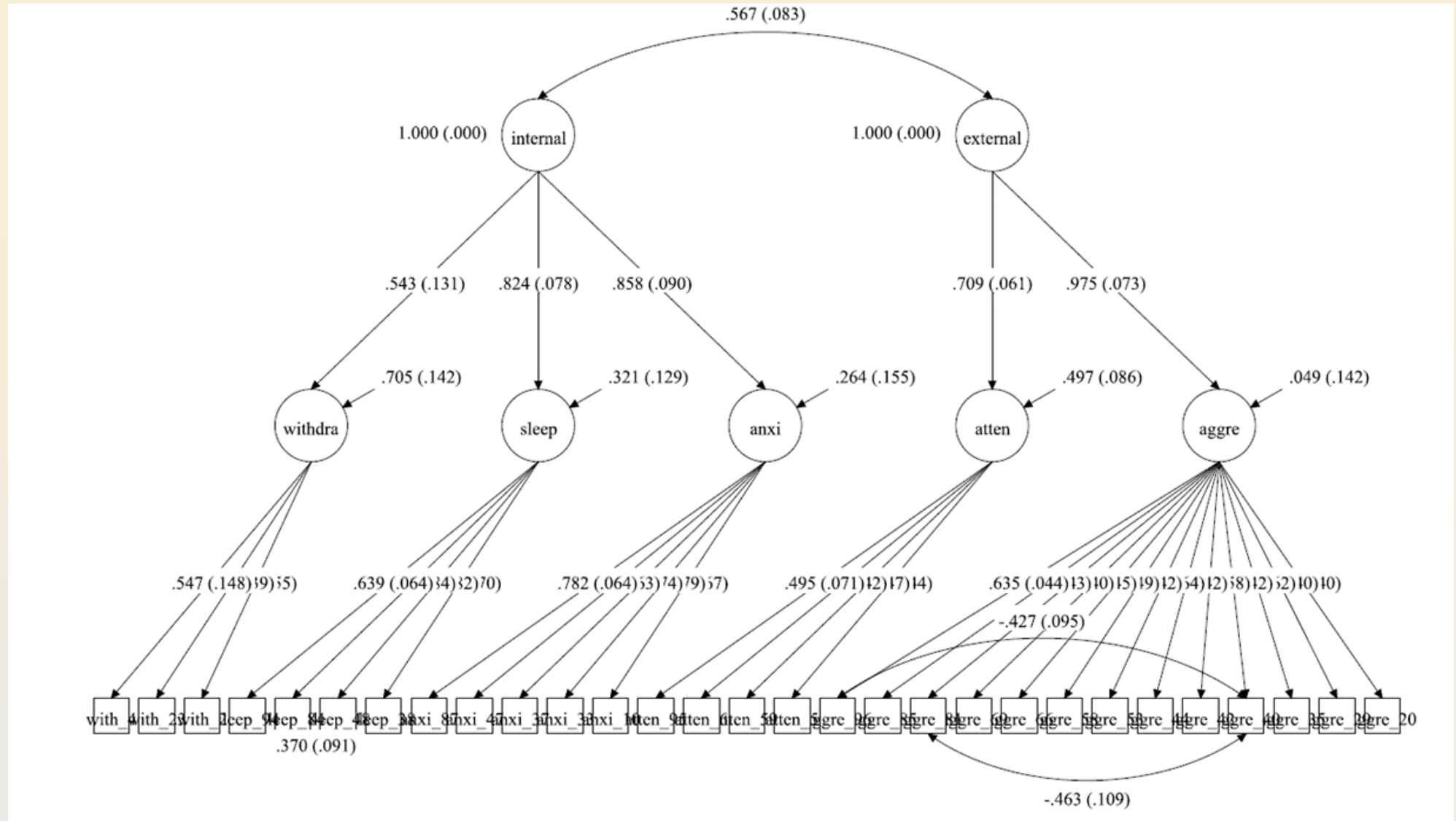
# 1<sup>st</sup> order correlated model

RMSEA = 0.03 CFI = 0.96 TLI = 0.96 WRMR = 0.95

Estimated Correlation matrix for the five remaining first order latent variables of aggressive behaviour, attention problems, anxious, sleep problems, and withdrawn behaviour.

	Aggression	Attention	Anxious	Sleep problems	Withdrawn
Aggression	1.000				
Attention problems	0.7	1.000			
Anxious	0.5	0.3	1.000		
Sleep problems	0.4	0.4	0.7	1.000	
Withdrawn	0.25	0.15	0.5	0.6	1.000

# 2<sup>nd</sup> order model for five individual subscales



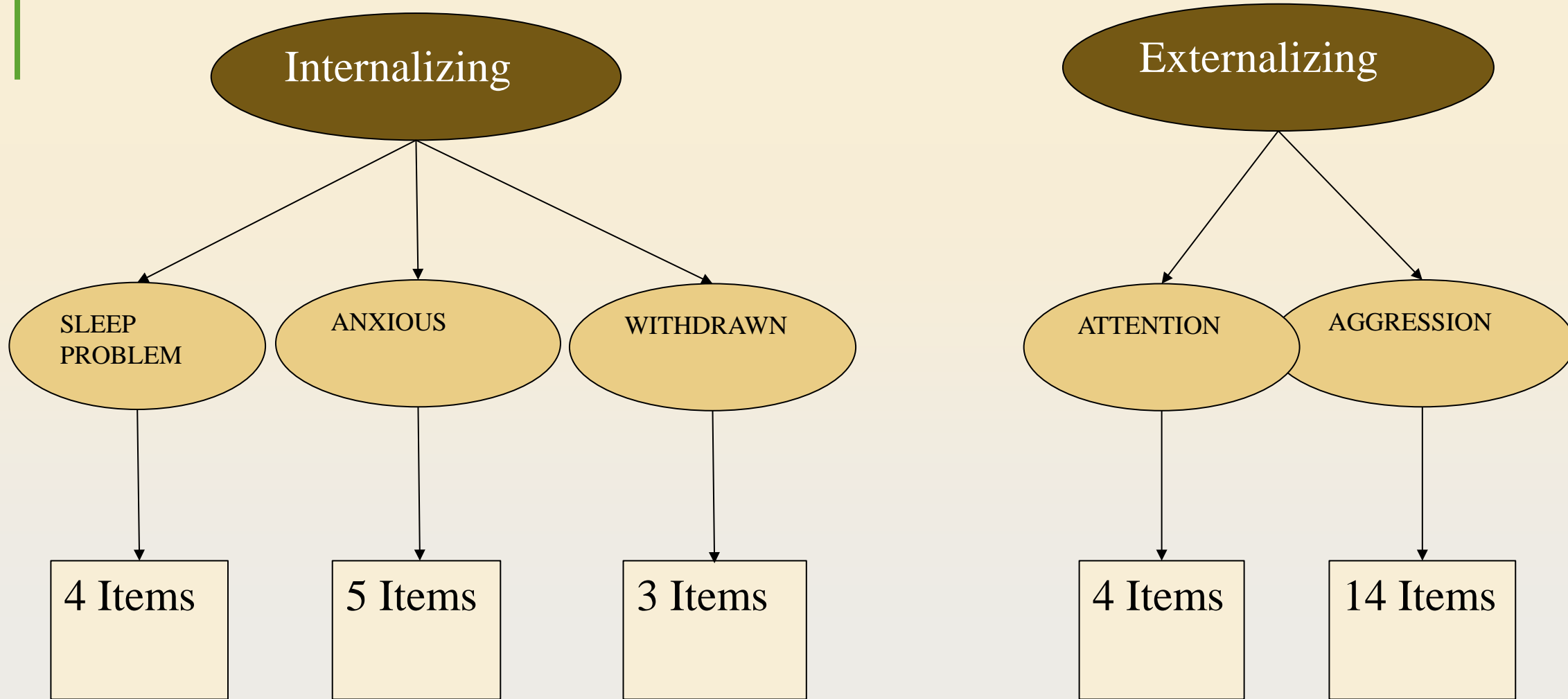
# 2<sup>nd</sup> order model for five individual subscales

RMSEA = 0.03

CFI = 0.96

TLI = 0.96

WRMR = 0.96



## 2<sup>nd</sup> order model for five individual subscales

RMSEA = 0.03

CFI = 0.96

TLI = 0.96

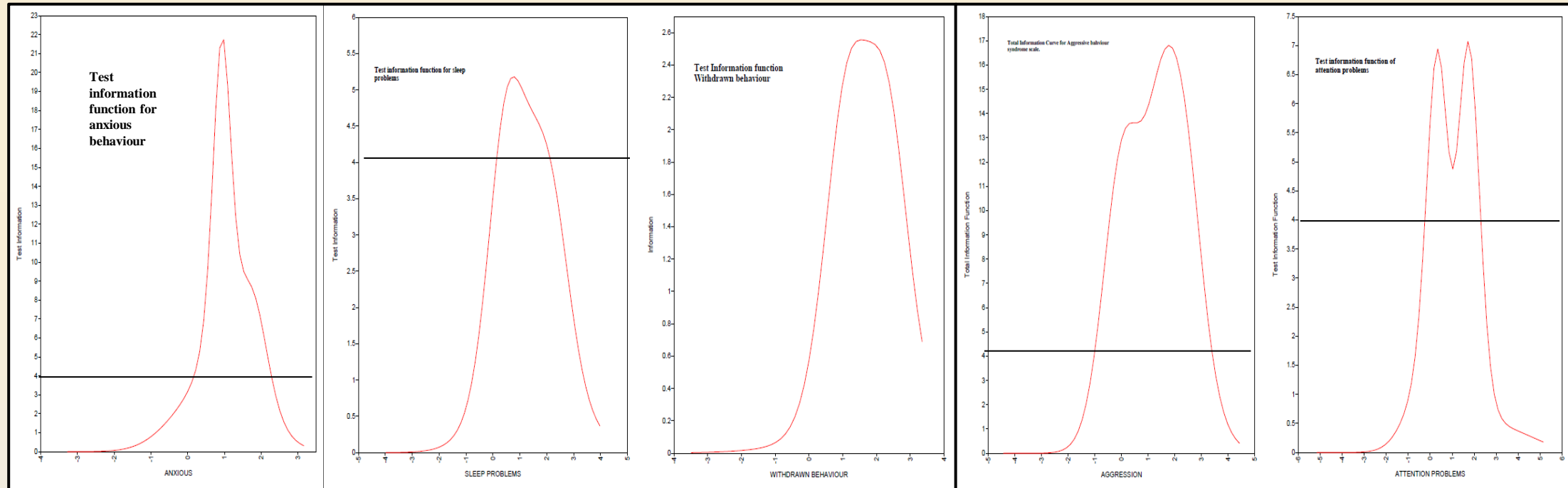
WRMR = 0.96

### Estimated correlation matrix for the first order and second order latent variables

	Aggression	Attention	Anxious	Sleep	Withdrawn	Internalizing	Externalizing
Aggression	1.0						
Attention	0.7	1.0					
Anxious	0.5	0.3	1.0				
Sleep	0.5	0.3	0.7	1.0			
Withdrawn	0.3	0.2	0.5	0.4	1.0		
Externalizing	0.9	0.7	0.5	0.5	0.3	1.0	
Internalizing	0.5	0.4	0.9	0.8	0.5	0.6	1.0

The estimated correlation between internalizing and externalizing was 0.6 (P value <0.0001)

# Reliability of subscales



Anxious	Sleep Problems	Withdrawn	Aggressive	Attention
$=22/23 = 95.6\%$	$=5.2/6.2 = 84\%$	$= 2.6/3.6 = 72.2\%$	$= 17/18 = 94.4\%$	$= 7/8 = 87.5\%$

Withdrawn subscale is not very reliable (Test information function less than 4)

# Conclusions

- Somatic problems subscale did not fit the data well.
- Although emotionally reactive subscale had a good model fit
  - However, it was highly correlated with anxious and aggression subscales.
  - Hence, it was removed from further analysis.
- 1<sup>st</sup> order model with five sub scales was a good fit
- 2<sup>nd</sup> order model with five sub scales was a good fit
  - Two 2<sup>nd</sup> order latent variables were significantly correlated indicating the possibility of 3<sup>rd</sup> order latent variable.
- Individual subscales had good reliability and discriminant capacity

# Next Step

- Validate the parsimonious re-specified model using the longitudinal sample.

