

# Reflective models

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## **The co-developmental dynamic of sport and school burnout among student-athletes: The role of achievement goals**

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My examples are picked from this paper.

The used latent phenomenon is school burnout which cannot measure directly.

The development of burnout scale has revealed that this phenomenon is three dimensional consisting exhaustion, cynicism and inadequacy.



I often sleep poorly because of matters related to my schoolwork

1 = completely disagree

2=..

3=..

4=..

5 = completely agree

School exhaustion is a latent phenomenon and cannot be measured directly. The answer to the questions related to school exhaustion reflects the degree of school exhaustion.

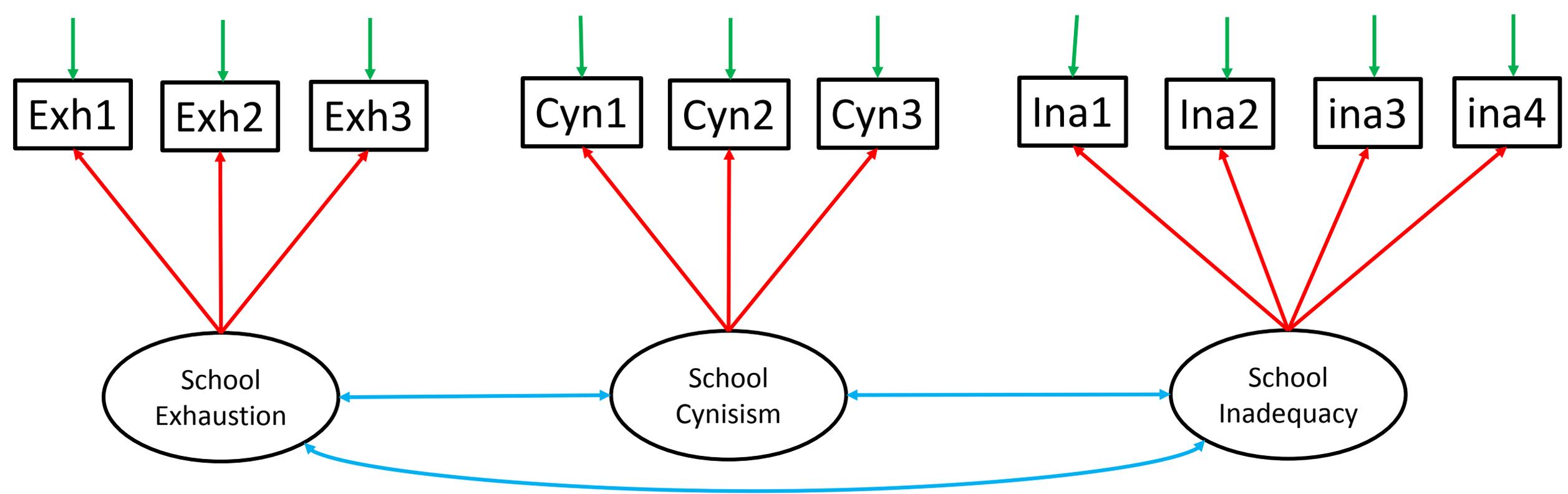
This question could reflect also other phenomenon. The idea is to find collection of questions (those) with common variation that reflects school exhaustion.

School burnout was measured using the **School Burnout Inventory (SBI; Salmela-Aro & Näätänen, 2009)**. The scale consists of 10 items, of which

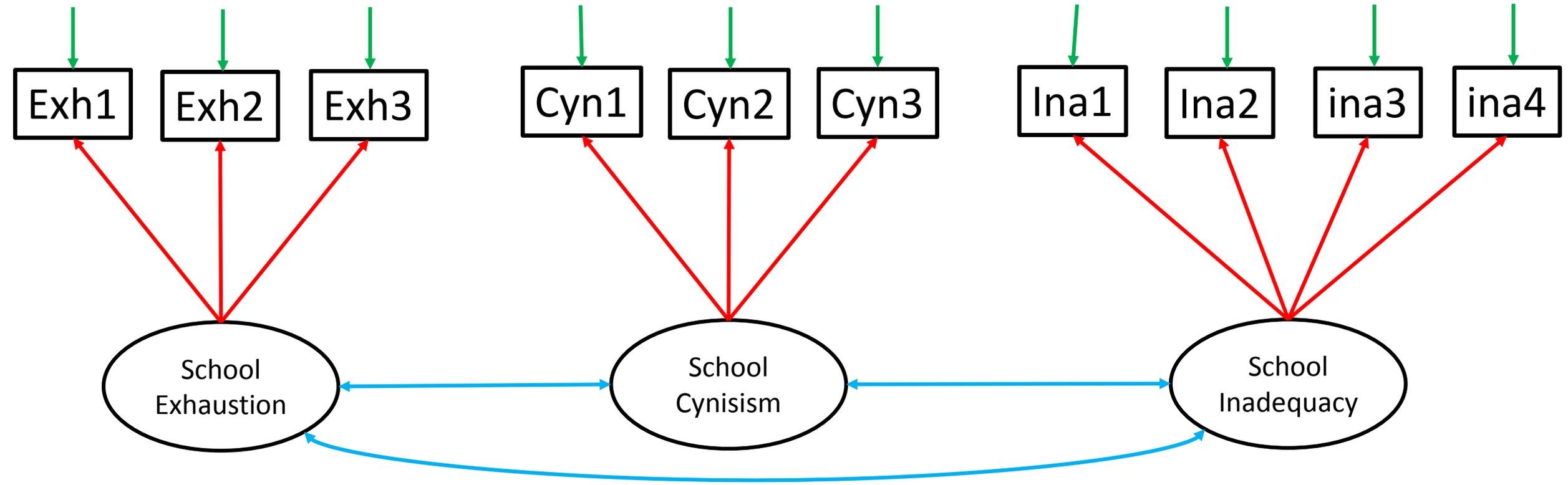
**4 measure exhaustion at school (e.g., *I often sleep poorly because of matters related to my schoolwork*),**

**3 measure cynicism toward the meaning of school (e.g., *School doesn't interest me anymore*) and**

**3 measuring feelings of inadequacy as a student (e.g., *I used to achieve more in school*). All items were rated on a 5-point Likert scale (1 = completely disagree; 5 = completely agree).**

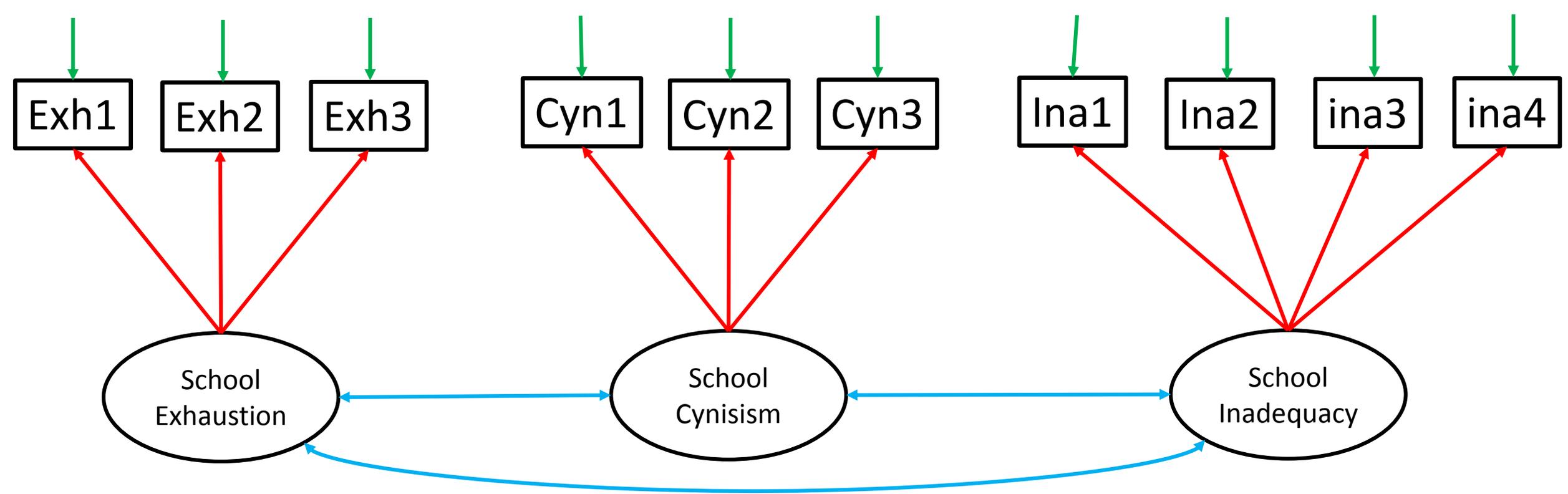


**Specified theoretical model of burnout says; the covariation between first three question are due to variation in latent phenomenon of school exhaustion; the covariation between third, fourth and fifth questions are due to variation in latent phenomenon of school cynicism and covariation between last four questions are duo to variation in latent phenomenon of school inadequacy.**

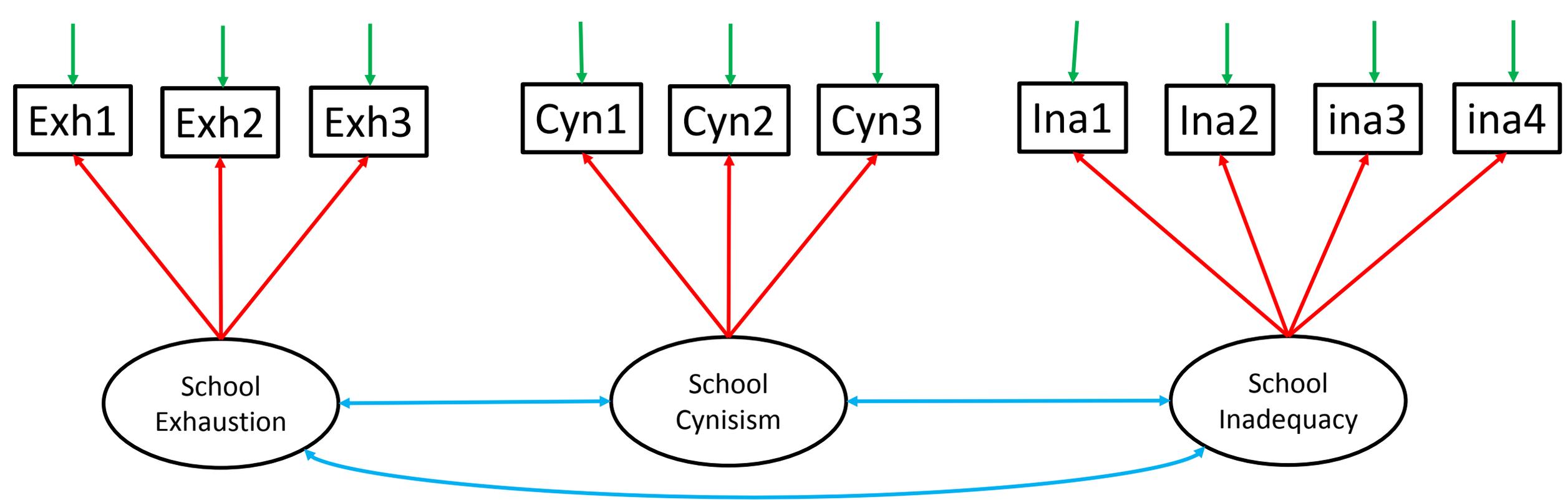


**In the obtained answers, however, there is variation that is neither associated between the questions nor the measured phenomenon.**

**We can use the sum of questions and achieve a very reliable index of burnout. Reliabilities is near to .80 of each subscales. Still there is about 20 % of error variation in the sum and result in lower associations or even spurious association.**



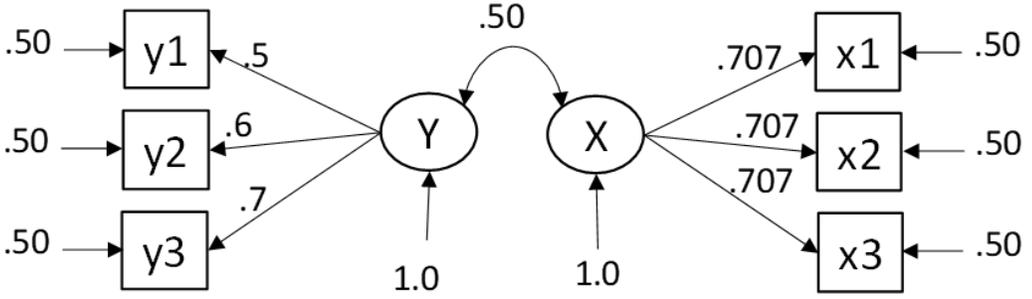
The blue two headed arrows means that the three sub dimension of burnout are expected to correlate. This means that the observed correlation between Exh1 and Cyn1 exists only because of the underlying correlation between latent school exhaustion and latent school cynicism.



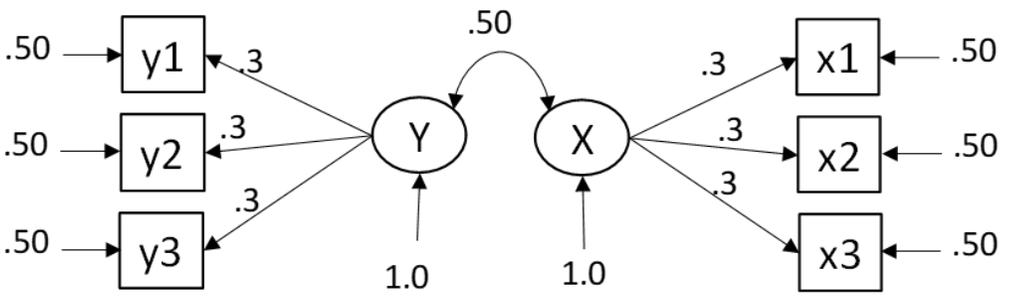
With structural equation model we can test if this measurement structure fits to the data. The larger the sample size the more accurate the parameter estimates are and more sensitive for detecting deviations which require model modifications.

Ongoing simulation research (Asko Tolvanen, Jarkko Tolvanen)  
 the two tested structural equation models shown below are  
 repeated 10.000 times

True population values



Sample size is 100  
 Standard deviation of factor loadings is (are)  
 .11  
 Standard deviation of the correlation between  
 the factors (are) is .12



Sample size is 100  
 Standard deviation of factor loadings is (are)  
 .26  
 Standard deviation of the correlation between  
 the factors is (are) .69

The minimum number of questions is three but

- the smaller the factor loadings are the more questions we need (or we need a larger sample size) to achieve reliable results
- the smaller the association between the phenomena of interest the larger sample size is needed to prove statistical significance

How the model fits to the data?

The known problem using chi-square test is that it is very sensitive for detecting minor differences between estimated model and observations in the case the sample size is large.

Ongoing research of model fits (Tolvanen Asko, Tolvanen Jarkko) proves that using chi-square test, **when 10 items are continuous and normally distributed and sample size is N=200**, the test works well.

**Increasing the number of items to (is) 20** chi-square test rejects the model fit at  $p < .05$  level in 11% estimated samples (**the actual rejecting level is  $p=.11$** ).

Root Mean Square Error of Approximation (RMSEA < .06)  
is one timely used index proving that the model fits to the data.

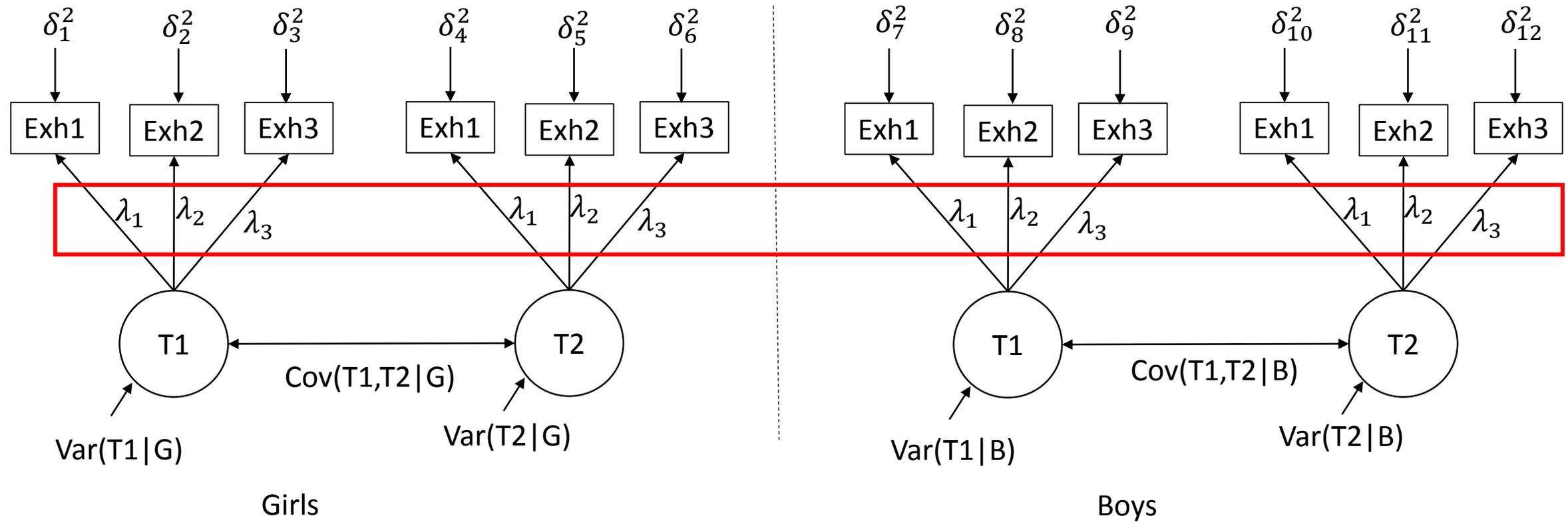
Ongoing research of model fits (Tolvanen Asko, Tolvanen Jarkko)  
proves that when sample size is at least 250, RMSEA works well  
and is independent of model complexity.

Conclusion: The needed sample size depends on the size of the  
factor loadings, number of indicators, how small the effect size  
of the phenomenon is, and whether there is a need to test the  
model fit. One way to evaluate the needed sample size is a use  
simulation study.

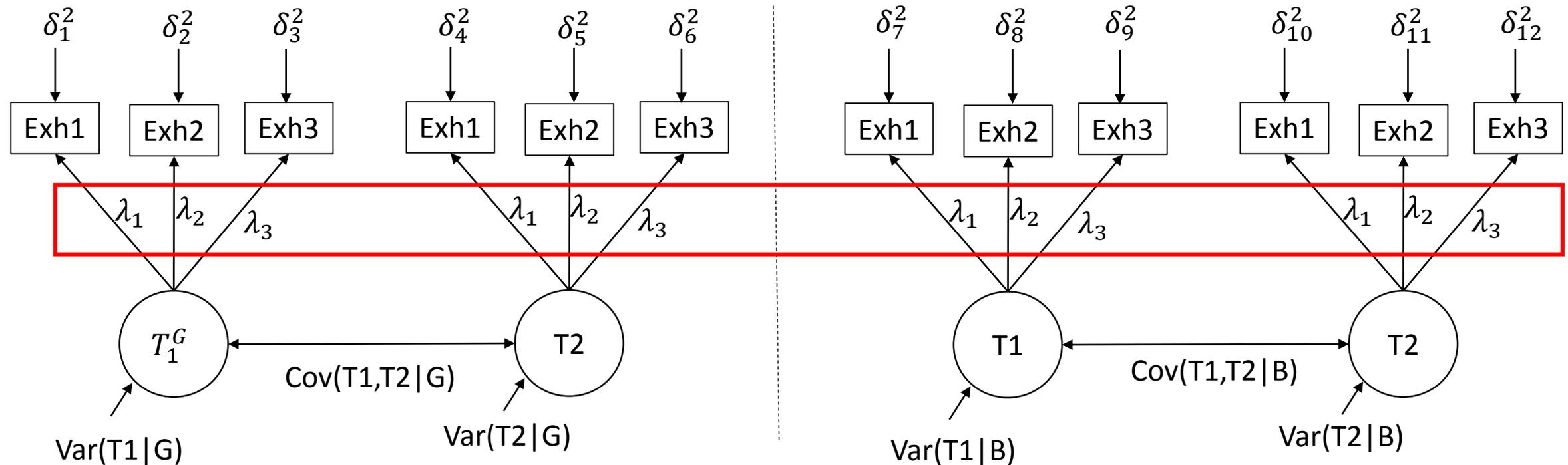
Does the measurement model work equally across time and equally between groups?

The level of measurement invariance can be tested by comparing nested models. Ask if

- factor loadings can be set equal across time/groups
- Intercepts of observed variables and factor loadings can be set equal across time/groups
- Intercepts of observed variables, factor loadings and error variances of observed can be set equal across time/groups



**In order to compare the factor variance and covariance of identical phenomena, the factor loadings must be equal.**



Boys

Girls:  $Exh1 = \nu_1 + \lambda_1 \times T_1^G + \text{error}$   
 Boys:  $Exh1 = \nu_1 + \lambda_1 \times T_1^B + \text{error}$

**In order to compare factor means across time and/or across groups intercepts of observed variables and factor loadings must be equal across time and/or groups. So the difference in the mean of the observed variable is due to the difference in factor means.**

We can use SEM model in hierarchical data: students are nested in classroom.

The mean level of burnout across school classes variation is more than randomly can expect. So the variation in latent factor should be divided between school classes and individuals.

Factor loadings should be set equal when measuring individual level or school class level. Additionally, all the variation in school class level in ideal case is due the phenomenon so the residual variances of observed variables are zero. Invariances can be tested.

We can use SEM model to find homogeneous latent groups from data.

The idea could be that the mean level of latent factors differs in unknown groups (latent classes in mixture modelling).

At least factor loadings and intercepts of observed variables should be set equal. Invariances are expected to hold.

# Structural equation model

Scales of observed variables are continuous (maybe normally distributed,) categorical, count or model consist mixed scales

Amount of missing values and types

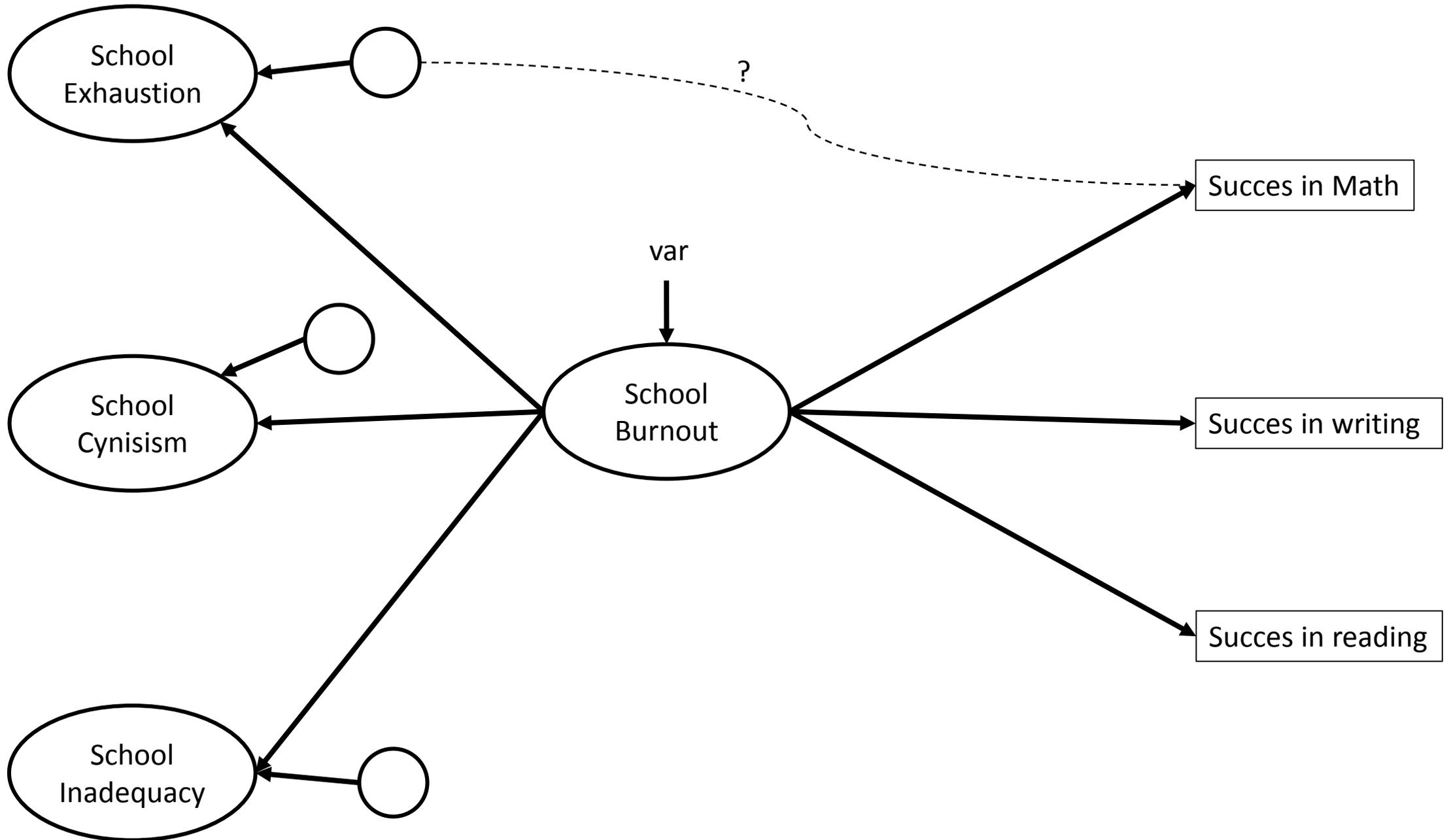
Missing at Completely random(MCAR)  
Missing at random (MAR)  
Non-missing at random (NMAR)

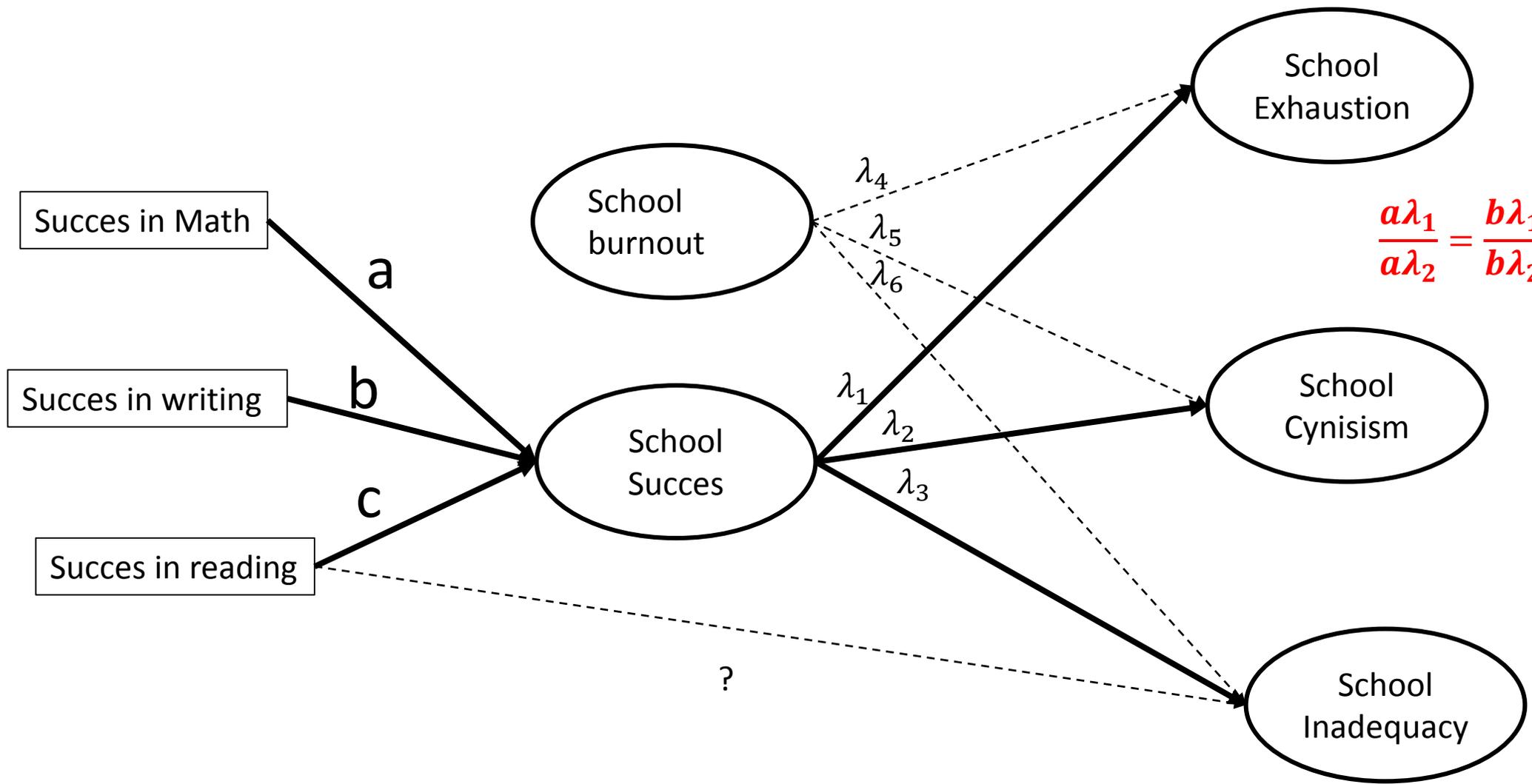
**Sample size**

Single group method  
Multigroup method  
Hierarchical data  
Latent groups

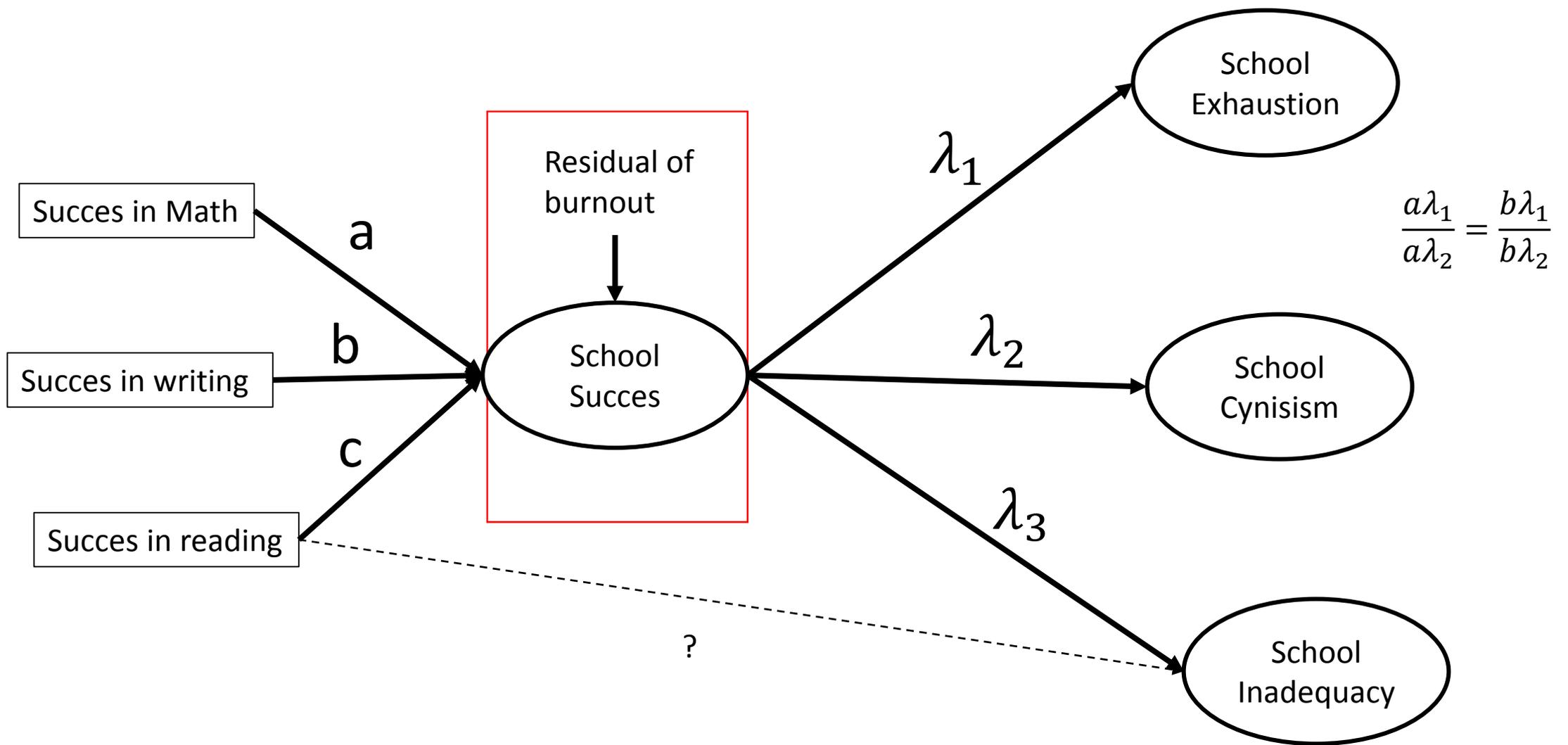
Estimation method:

Full information maximum likelihood  
Weighted least square methods  
Bayes method  
Bootstrapping

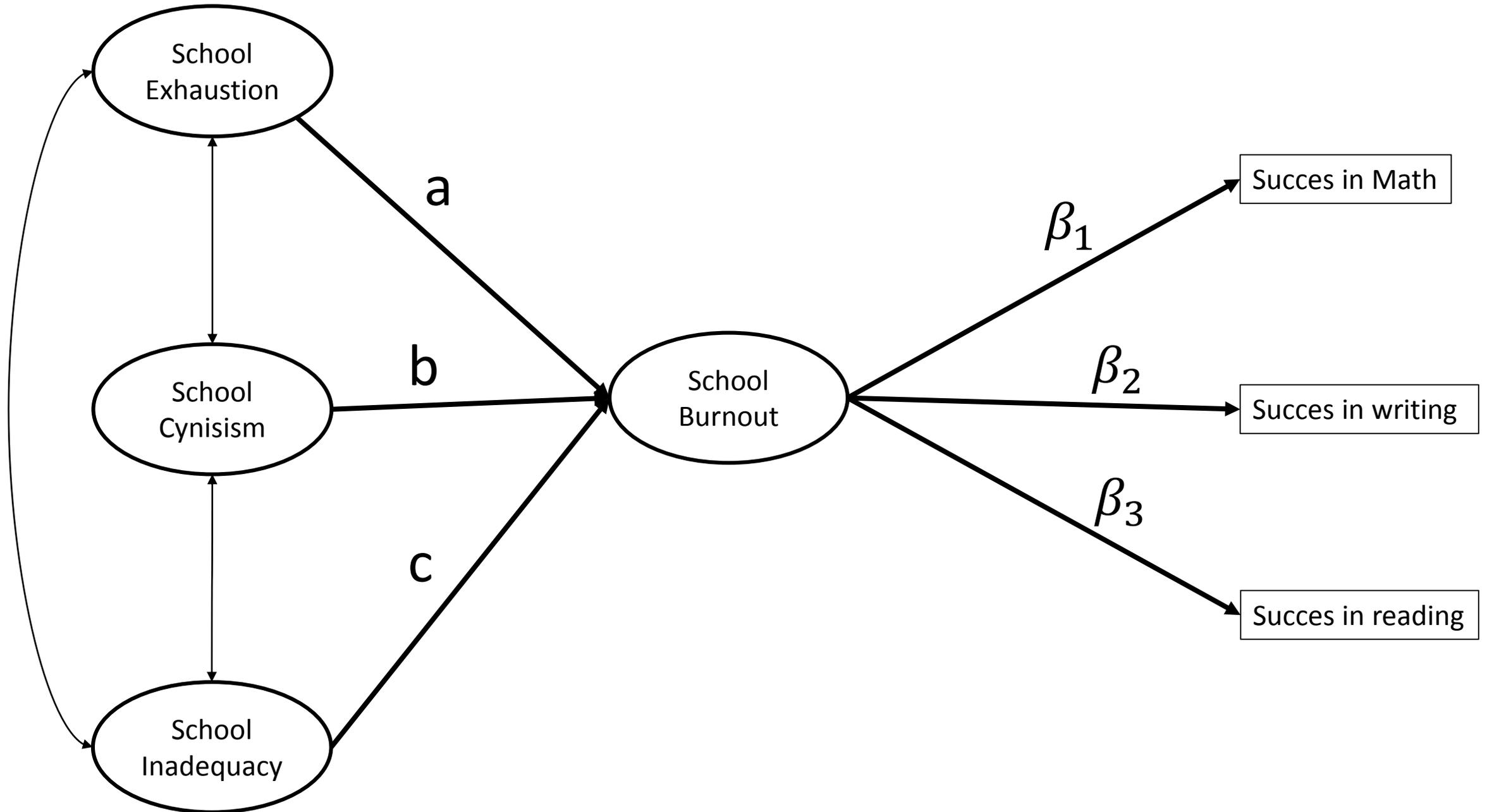




The level of school success independent of school subject explains proportionally equal part of the variation in burnout subscales.



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Thank You !