

# Modeling Developmental Processes in Psychology

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In this presentation I will first discuss the ways in which theory building and modeling are conceptualized in psychology. The theories and models can be differentiated according to whether they have been developed for heuristic purpose to integrate broader research fields, how broad phenomena they cover, and whether they can be tested or falsified in one experiment or study. From this point of view, metatheories, theories, models, and measurement models are shortly discussed. After this introduction, I will give a few examples of constructing metatheories, constructing theories, and modeling (both interindividual and intraindividual Variation). The presentation is concluded by discussing some key challenges in theory building and modeling.

# Modeling Developmental Processes in Psychology

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Research

# Modelling

- Has different meaning in different disciplines
- Has different meaning even within discipline, e.g.
  - social psychology
  - clinical psychology
  - experimental psychology
- My background is in **Developmental and Educational Psychology**

**In psychology, the modeling and theory building is understood as a complex process**

*For example*

**Metatheories**

Learning theory  
Psychoanalysis

**Theories**

Task-value theory  
Learned helplessness  
theory

**Models**

Expected relationships  
between constructs

**Measurement  
models**

Expected construct-  
Variable associations

**Variables**

Reading skill  
Anxiety

R  
E  
A  
L  
I  
T  
Y

Metatheories

Theories

Models

Measurement  
models

Variables



S  
C  
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**Theory  
building**

**Metatheories**



**Theories**



**Models**



**Measurement  
models**



**Variables**



**Phenomena**

**Modeling**

**Operatio-  
nalization**

**Theory  
building**

**Metatheories**



**Theories**

**Paradigms  
Traditions  
Cumulative  
evidence**

**Modeling**

**Models**



**Measurement  
models**

**Observations  
Data**

**Operatio-  
nalization**

**Variables**



**Phenomena**

*Rationale*

**Theory building**

**Metatheories**



Understand broader field



**Theories**



Direct research



**Models**



Test/ falsify theories



**Measurement models**



Test reliability of measurement



**Variables**



**Phenomena**

**Modeling**

**Operationalization**

# A few examples of ...

- Building a metatheory
- Developing a theory
- Modeling

# Metatheory

# Triangular theory of learning and motivation

- We have been doing research for 15 years on children learning and motivation → tens of empirical articles
  - I asked to give a plenary talk on our research
  - I sat on in our garden and was wondering:  
*“how the hell I can tell a story out of all these individual findings”*
- **Triangular theory of learning and motivation**

**Child**

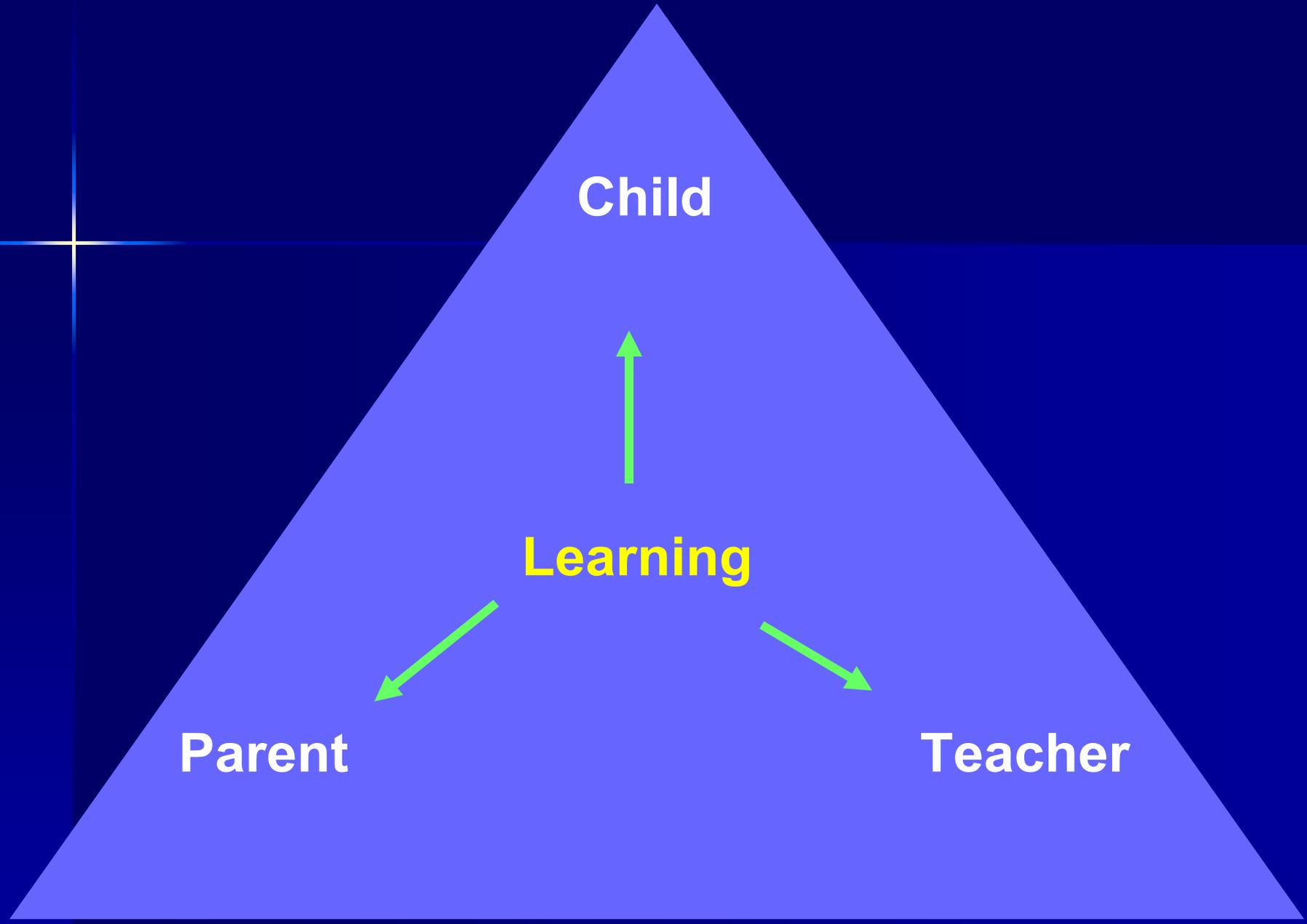
**Learning**

**Parent**

**Teacher**

**Previous conceptualizations**





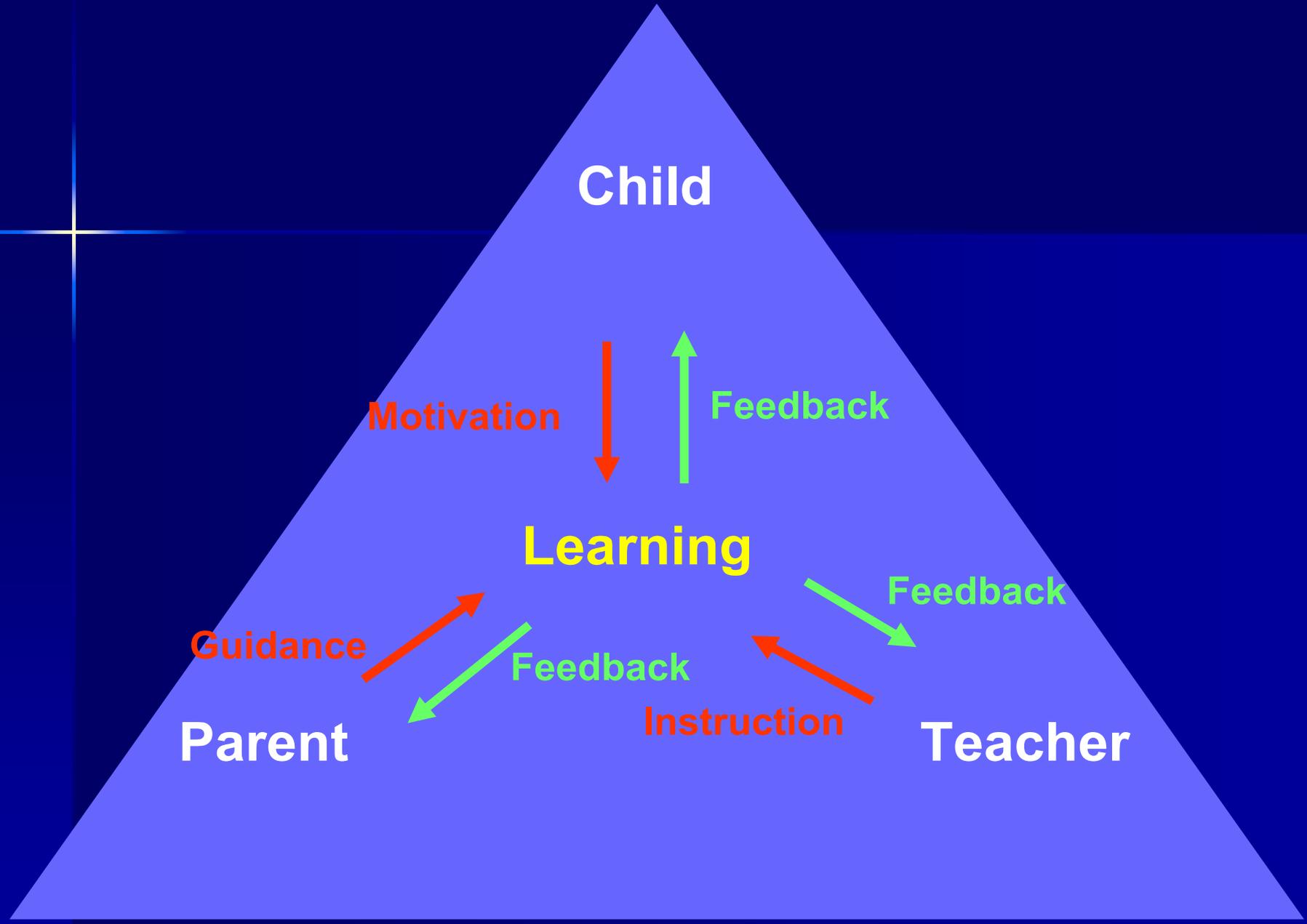
**Child**

**Learning**

**Parent**

**Teacher**

**An alternative view**



# Learning in interpersonal context II

# Each actor in the “triangle”

**Beliefs**

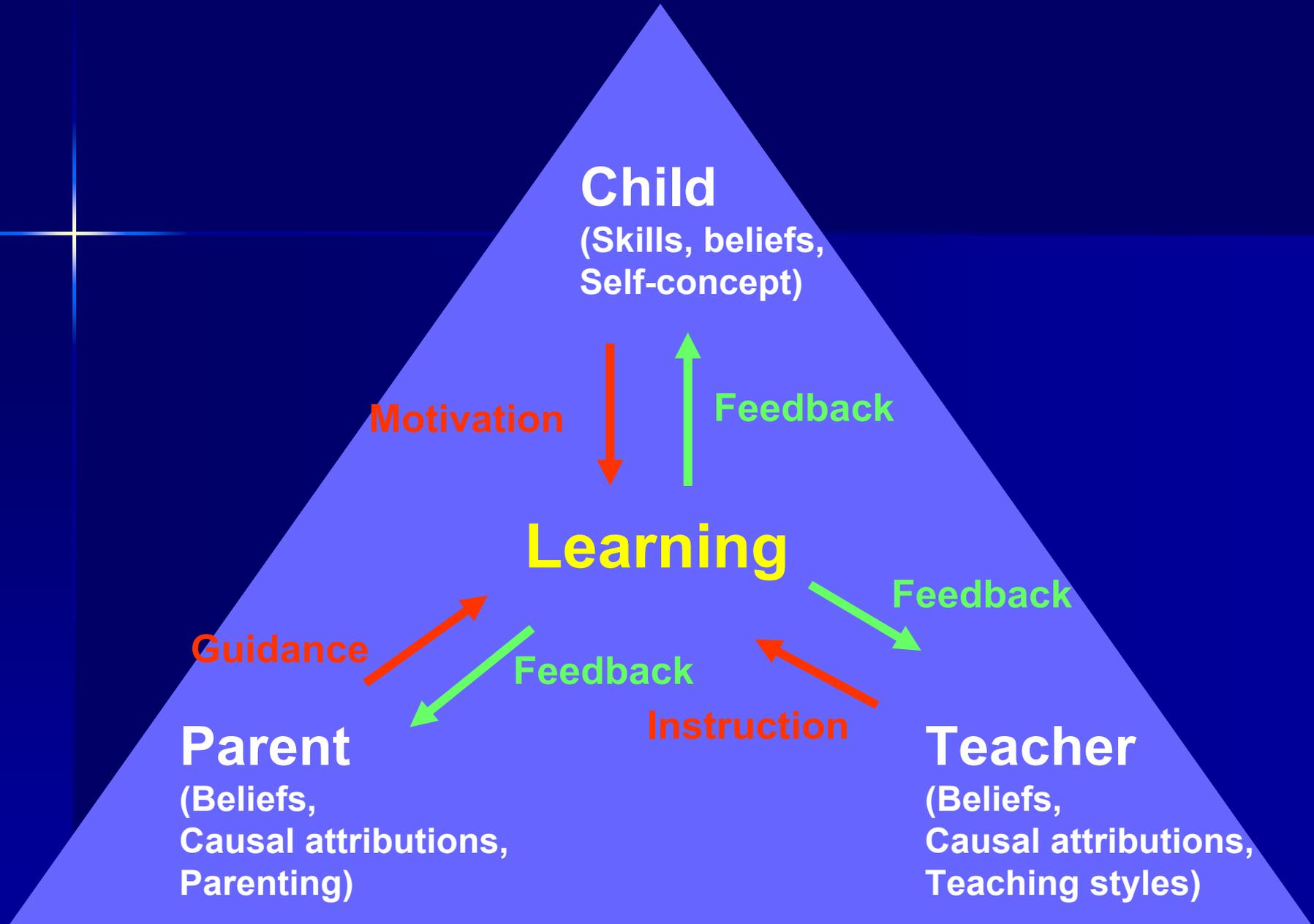
**Causal  
attributions**

**Emotions**

**Feedback**



**Behavior**



# Learning in interpersonal context

# Typical metatheory

- Cannot be proven or falsified by a single study or experiment
- A “heuristic” tool for thinking rather than well-specified theory

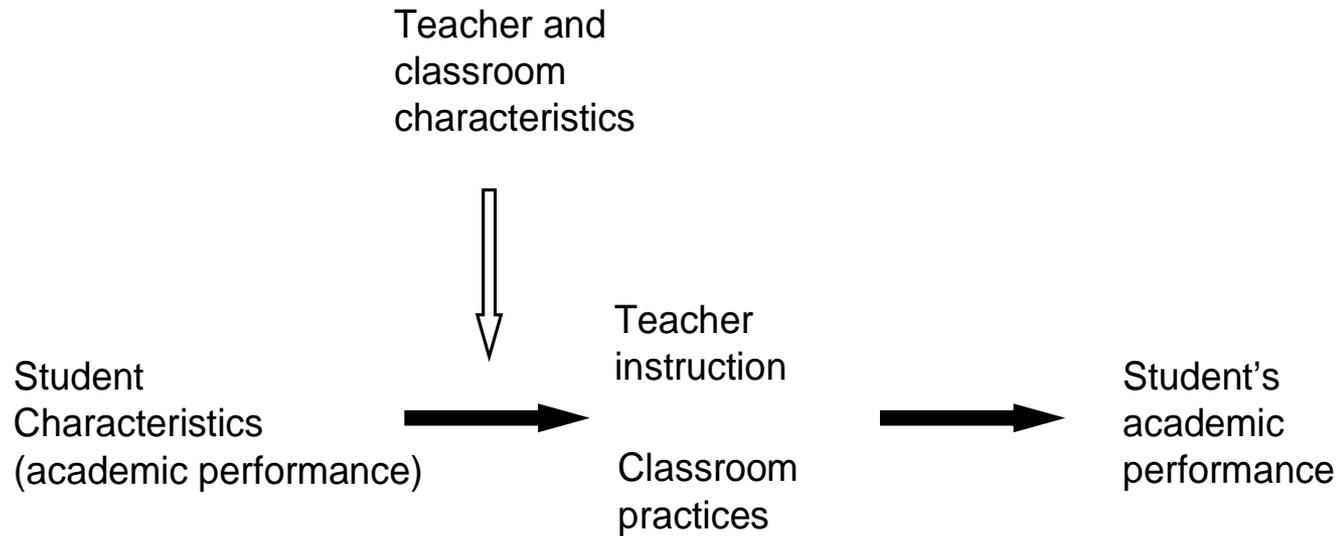
# Theory building

# Students' influence on teachers' instruction

- A model that is partly based on previous metatheory ...
- ... and partly one single personal experience ...
  - *"unhappy student"*

# Students' role in classrooms

(Nurmi, 2008)



# Modeling (inter-individual variation)

# Students' influence on their teachers

- We tested the previous theory by constructing a statistical model in which
- Teachers' attention to a particular student in Grade 1
- Predicted by students' literacy skills at the end of kindergarten

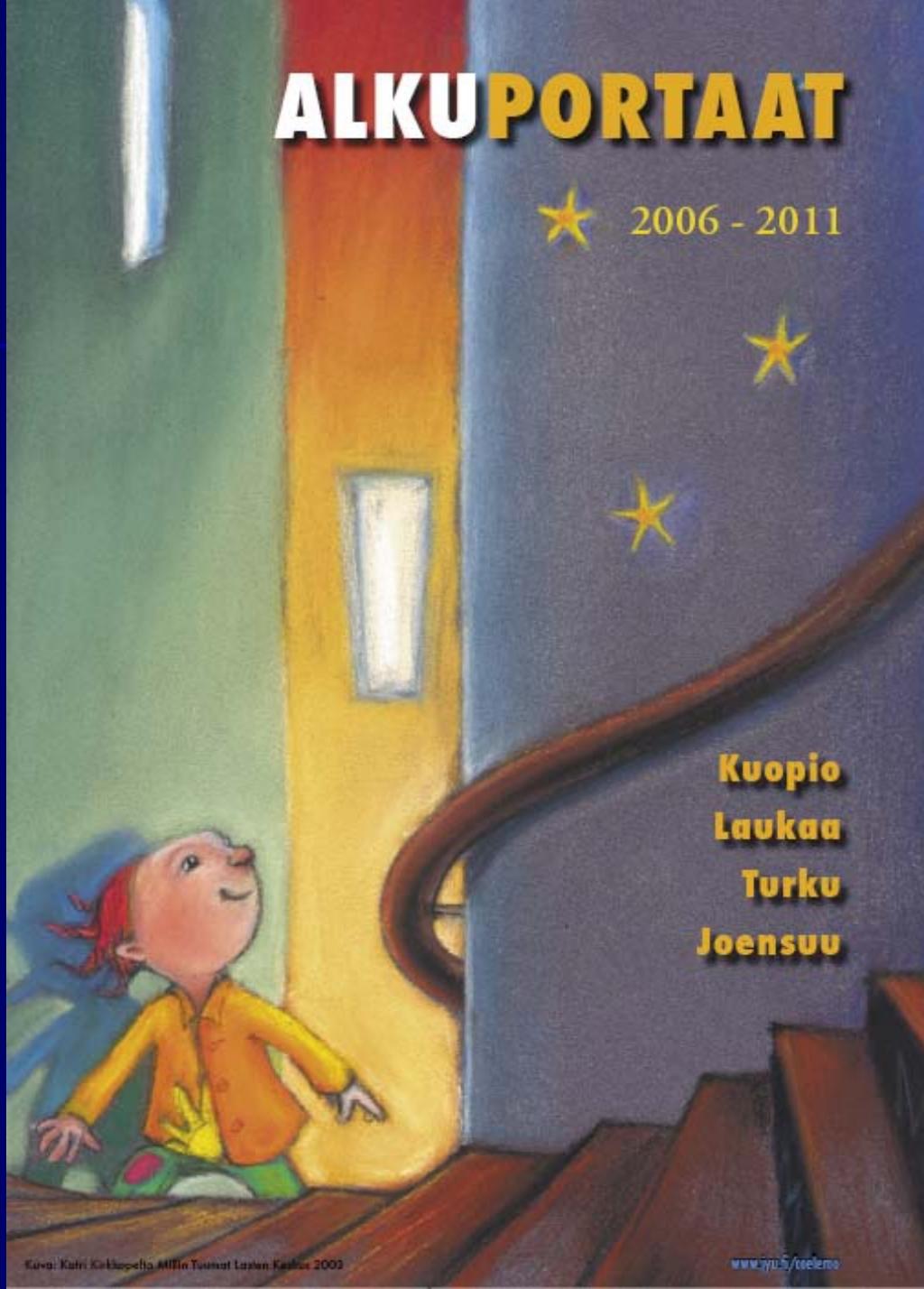
# Study

- Does a student's performance in (pre-) reading impact his or her teacher's instruction?
- Do teacher-related factors and structural feature of the classroom predict teachers' variation in how much they are influenced by their students characteristic?

# ALKUPORTAAT

★ 2006 - 2011

**Kuopio  
Laukaa  
Turku  
Joensuu**



# The First Steps study

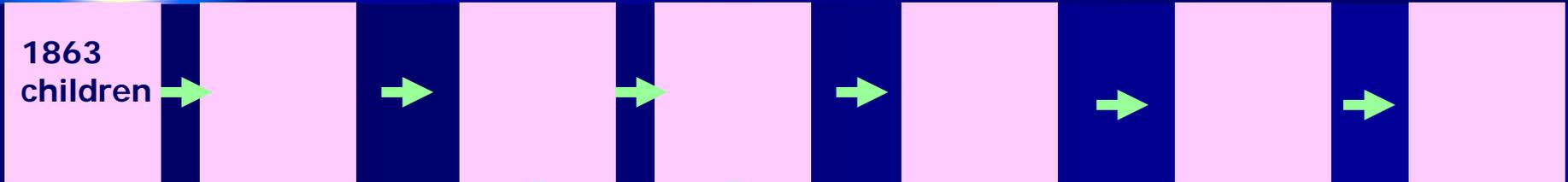
Kindergarten

1<sup>st</sup> grade

2nd gr.

3rd gr.

4th gr.



Individual testing

Parent ratings

Teacher ratings

Parents' Questionn.

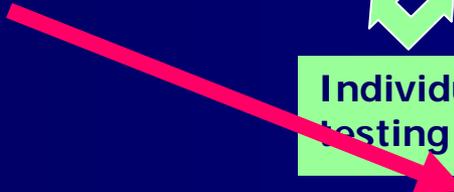
Parents' Questionn.

Parents' Questionn.

Teachers' Questionn.

Teachers' Questionn.

Teachers' Questionn.



# Measurements

## ■ Children's pre reading skills

- Phonological awareness  
( $\alpha=.73$ )
- Letter Knowledge  
( $\alpha=.94$ )
- Reading words and text  
( $\alpha=.86$ )

## ■ Teacher focus and attention

- in reading and writing
- in mathematics

## ■ Teacher and classroom variables

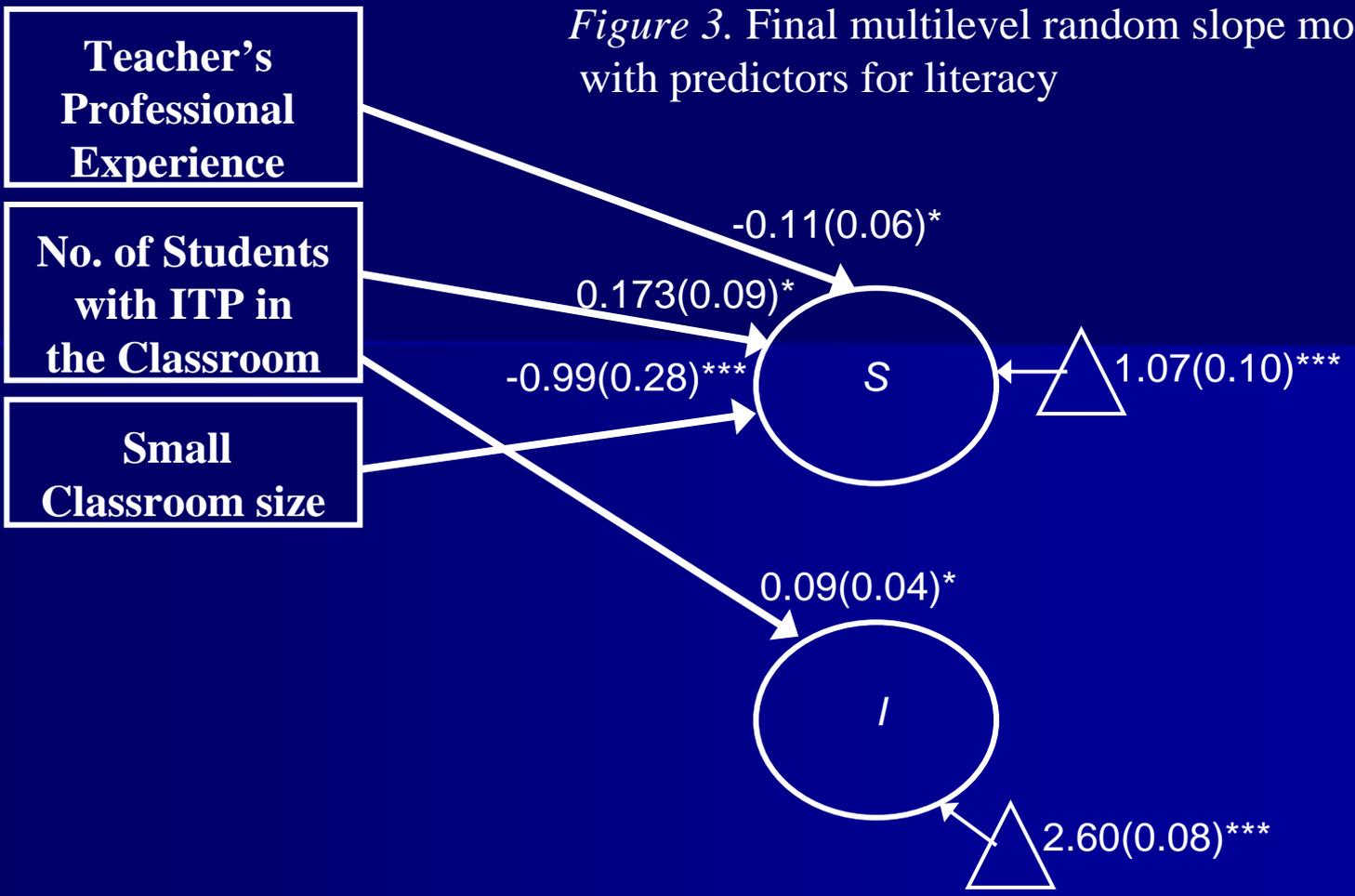
- Teacher experience
- Classroom size
- Number of students with individual educational plan (IEP) in the classroom

Figure 2. Complex model for the amount of instruction in literacy



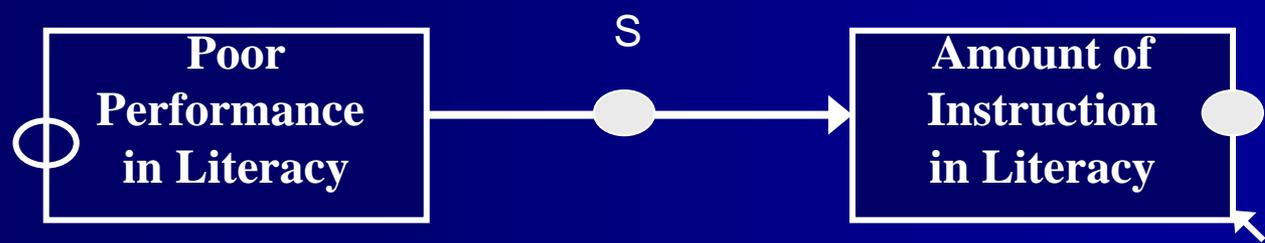


Figure 3. Final multilevel random slope model with predictors for literacy



*Between*

*Within*

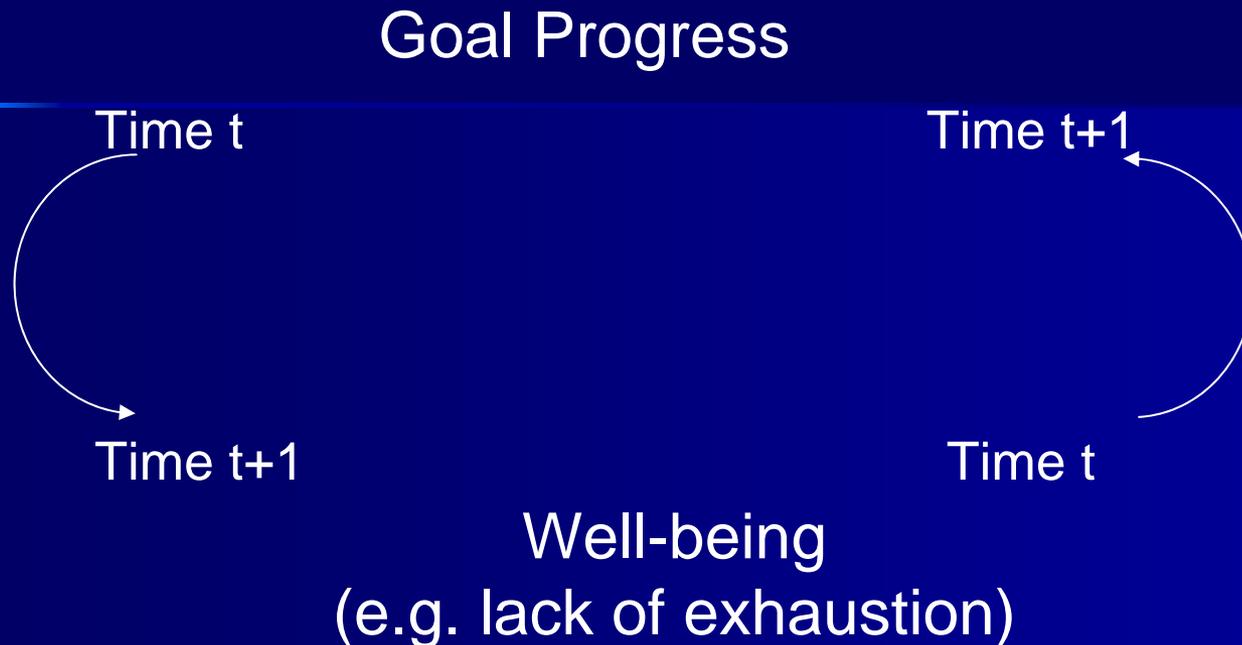


# **Modeling** (intra-individual variation)

# Goal appraisals and exhaustion

- A lot of research investigating the associations between goal appraisals (progress, stress, etc.) and people's well-being
- Some researchers have suggested that besides inter-individual variation also intra-individual variation should be examined, as the results might be different

# Goal progress and work-exhaustion as a dynamic system



**Tested model among individual cases**

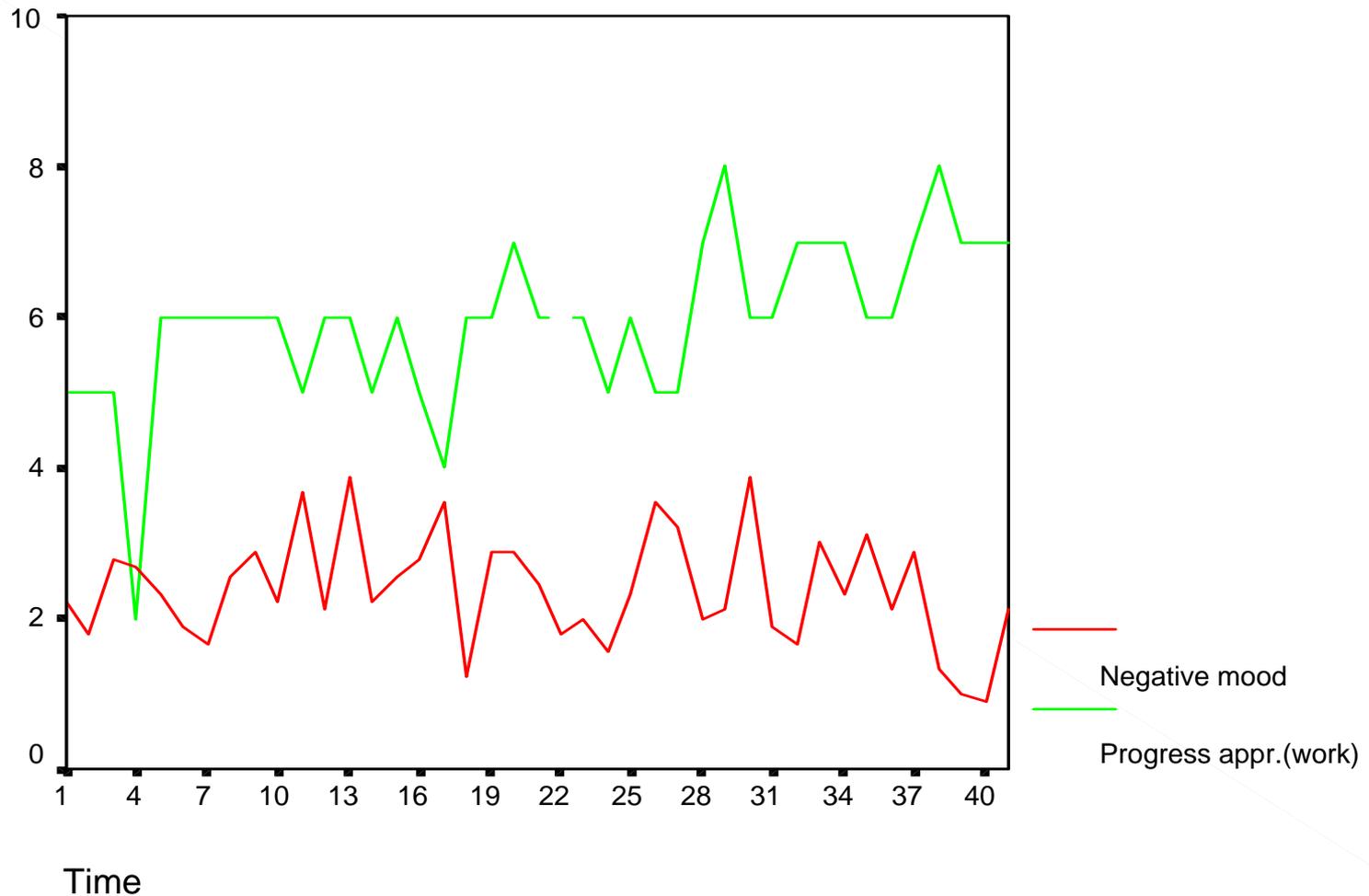
**Nurmi, J.-E., Salmela-Aro, K., Keskivaara, P., Näätänen, P. (2008).  
Confidence in work-related goals and feelings of exhaustion during a  
therapeutic intervention for burnout: A time series approach.  
*Journal of Occupational and Organizational Psychology, 81, 277-297.***

# Helsinki Burnout Intervention study

(Salmela-Aro, Näätänen & al.)

- 36 individuals suffering burnout at work
- Followed across a year-long psychotherapeutic intervention
- 40-50 measurements
- Time-series modeling across time

Example of data: **Red**= exhaustion,  
**green**=work-goal progress



# Analyses ...

- Were run separately for each of 36 individuals (time series analyses)
- By using dynamic factor analyses/ state-space models

# Dynamic factor analysis: Dynamic Autoregressive Factors Score model (DAFS)

$$(1) \quad y(t) = S a(t) + d + e(t)$$

$$(2) \quad a(t+1) = H a(t) + c + z(t)$$

In which,

$y(t)$  = observed random variable:  $p \times 1$

$a(t)$  = latent random variable:  $q \times 1$

$e(t)$  = observed residual random:  $p \times 1$

$z(t)$  = latent residual random:  $q \times 1$

$S$  = regression parameters  $y(t)$  on  $a(t)$

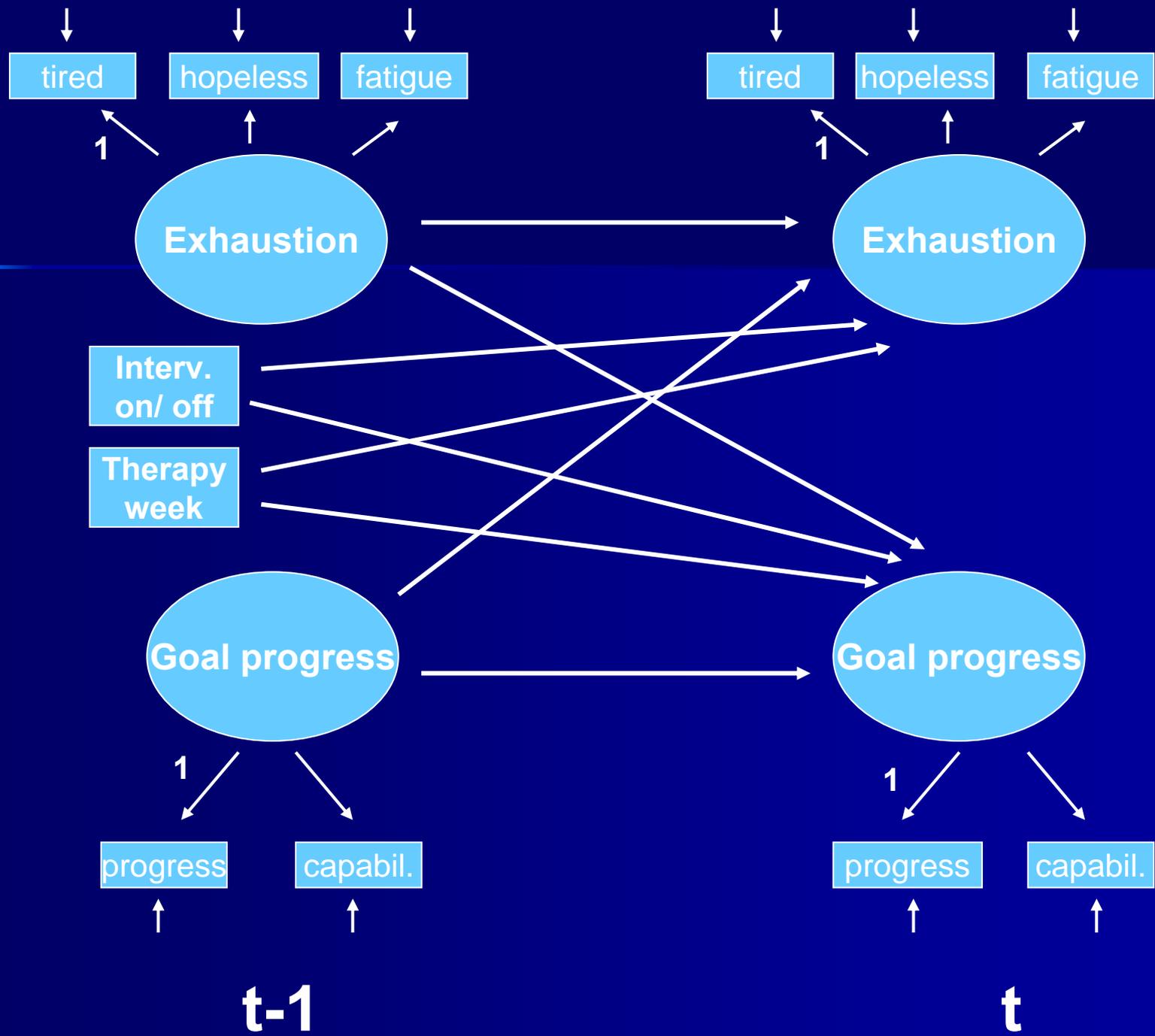
$d$  = intercept in regression of  $y(t)$  on  $a(t)$

$H$  = regression parameters  $a(t+1)$  on  $a(t)$

$c$  = intercept in regression of  $a(t+1)$  on  $a(t)$

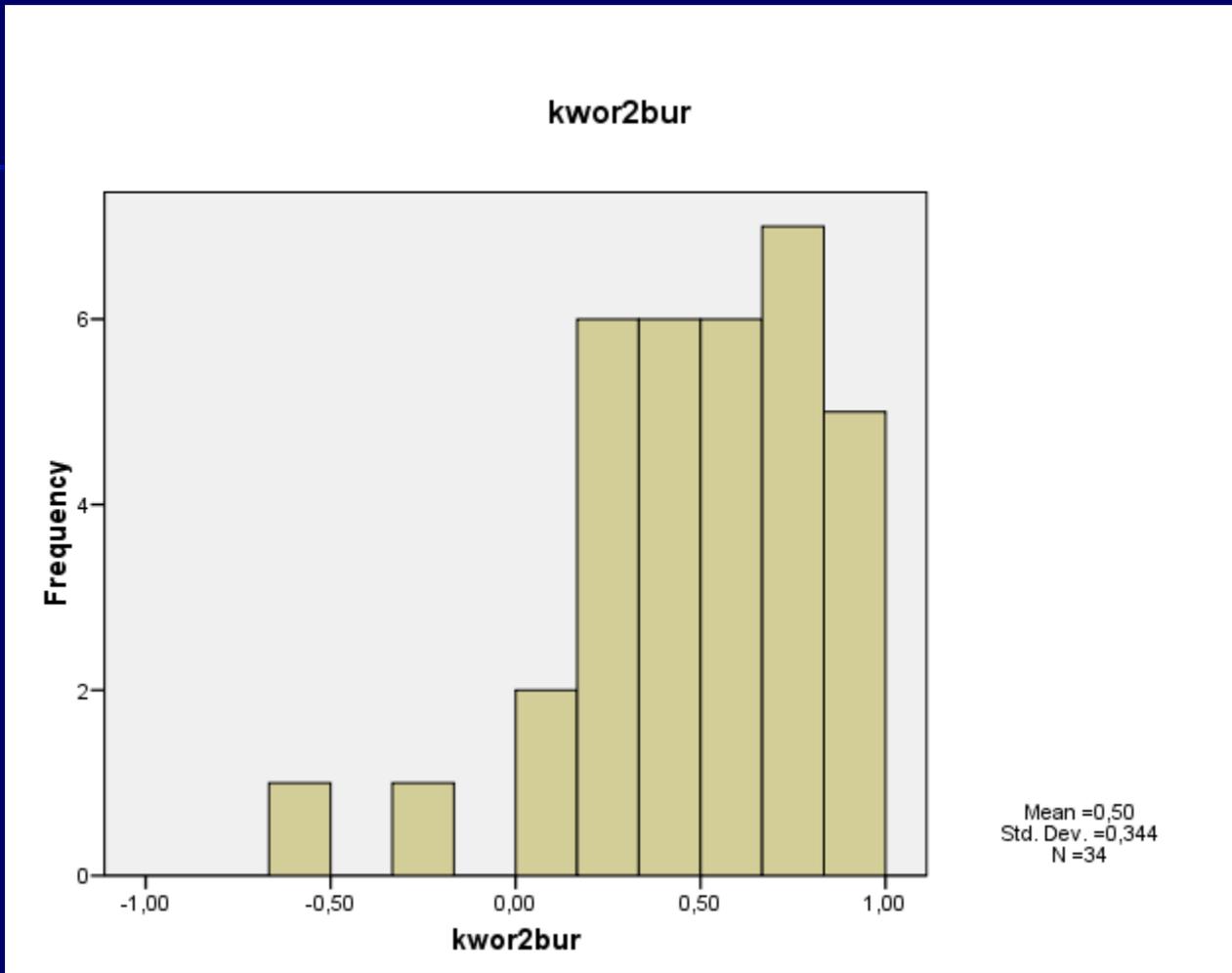
# The DAFS were run

- by using the MKFM2 program (see, <http://users.fmg.uva.nl/cdolan/>)
- suggested by Hamaker, Dolan and Molenaar (2002, 2003) for relatively short time-series.

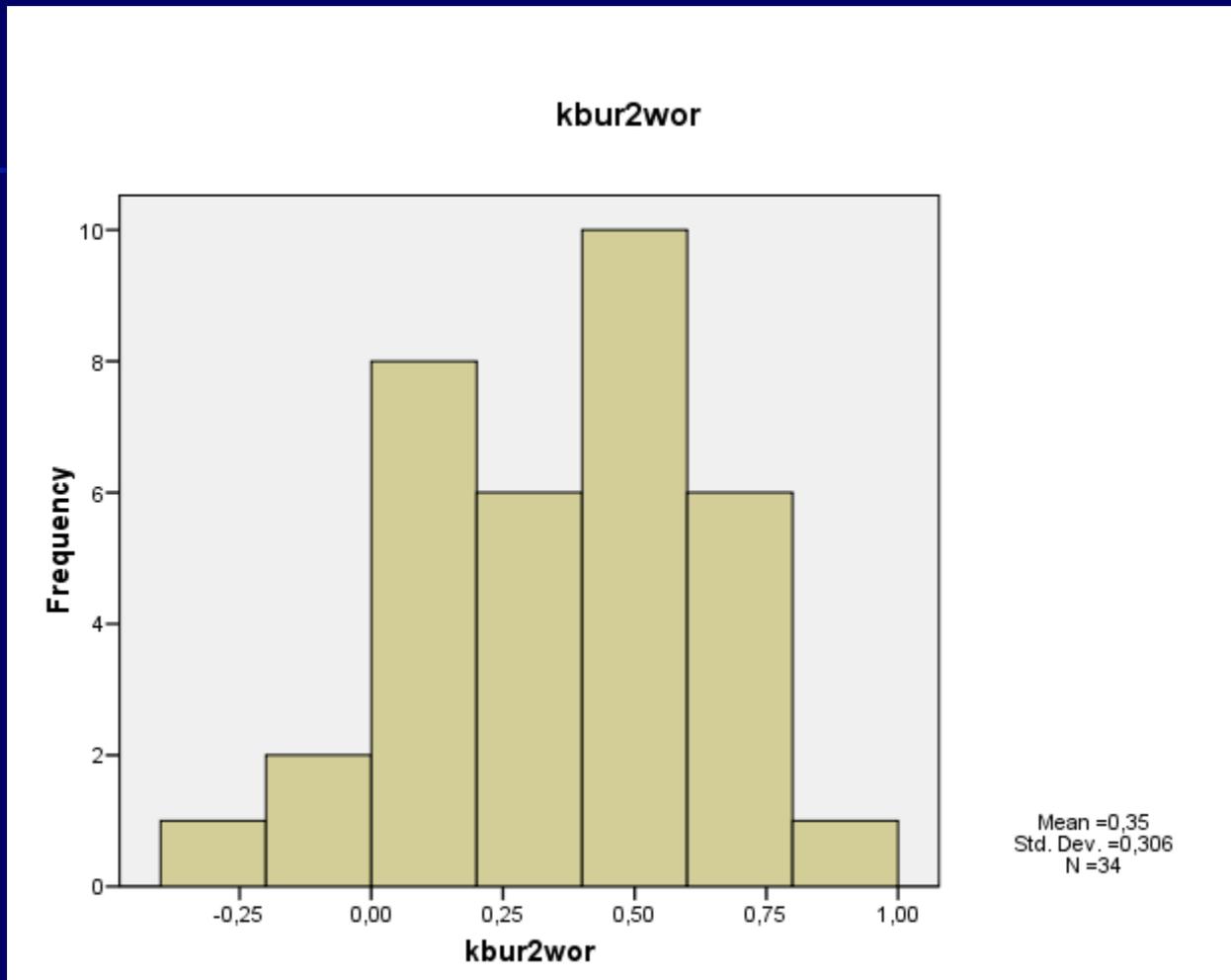


# The DAFS analyses showed ...

- Goal progress appraisals stable for most participants
- Work exhaustion stable for most participants



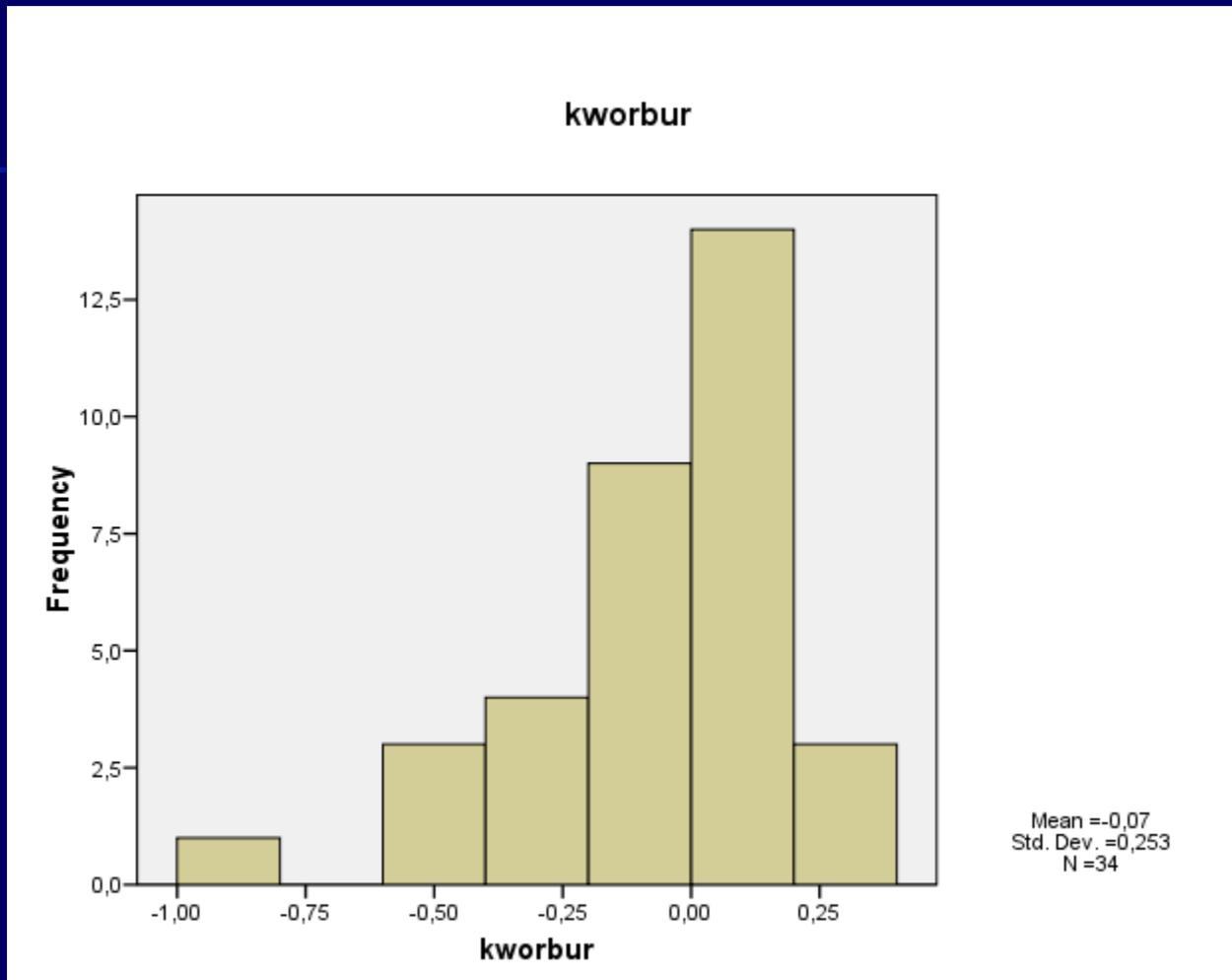
**Stability of goal progress**



**Stability of exhaustion**

# The DAFS analyses showed ...

- Lagged paths followed normal distribution



**Exhaustion → goal progress**



**Goal progress → Exhaustion**

# BUT ...

- By using individual DAFS parameters we were able to predict (by regr. analysis) those who benefit from therapy and those who did not
- Low stability in goal progress (fluctuation) predicted increase in well-being during psychotherapy
- Low stability in work-exhaustion (fluctuation) predicted decrease in work-stress during psychotherapy

**Regression Analyses predicting Work-Related Stress and Well-Being by the stabilities of exhaustion and goal progress.**

<b>Predictor</b>	<b>Work-related stress</b>		<b>Well-being</b>	
	<i>Beta</i>	<i>incR2</i>	<i>Beta</i>	<i>icrR2</i>
<b>1. Variable at pre-measurement</b>	<b>.56***</b>	<b>.31</b>	<b>.58***</b>	<b>.33</b>
<b>2a. Stability of exhaustion</b>	<b>.31*</b>	<b>.41</b>	<b>-.27</b>	<b>.41</b>
<b>3b. Stability of goal progress</b>	<b>-.09</b>	<b>.32</b>	<b>-.33*</b>	<b>.44</b>

# Moreover

- Burn-out in pre-measurement predicted
  - high stability in work-exhaustion
  - negative impact from work-exhaustion to goal confidence
- High self-esteem predicted
  - low stability in goal confidence

## Correlations between self-esteem and burnout in pre-measurement and stabilities of and lagged relationships between goal confidence and work-exhaustion

### Variables

	Self-esteem	Burnout
Stability of work-exhaustion	.05	.33**
Stability of goal confidence	-.43**	-.09
Cross-lagged path from work-exhaustion to goal confidence	-.19	-.33**
Cross-lagged path from goal confidence to work-exhaustion	.16	.18

# So far, I have provided you examples of ...

- Building metatheory
- Building theory
- Modelling (interindividual and interindividual variation)
- In psychology

# Some critical issues

- How much chosen traditions, theories and operationalizations influence the view we build up from reality
- How much lack of previous theories influence the view we build up from reality
  - e.g. if chosen variables are selected without theoretical understanding
- Differences in traditions and theories may inhibit discussion among researchers interested in same phenomenon

# Some critical issues

- How narrow or broad theories should be
  - Narrow theories may decrease understanding of broader phenomena
  - Too broad theories may not be enough specific to explain what is really happening in reality
- How much researchers should use similar concepts (operationalizations) that allow them to compare their findings
- How much research is led by the topics that are easy to be investigated rather than the topic that are important

# Some critical issues

- How well we should be able to explain the phenomena we are studying?
  - 1%, 10%, 40%, 60%, 99%
- Statistical significance just tell us how large sample size we have
- How big effect size we should have to suggest it should be used in real life?
  - 4% (.20), 16% (.40), 49% (.70)

Thanks