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Attention, abstract thinking and school achievement among the Finnish 9th graders – multilevel analysis

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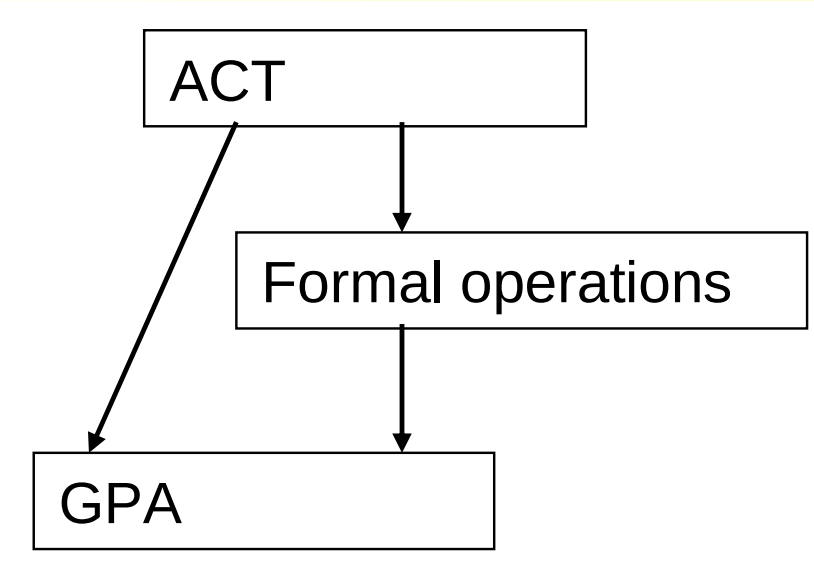
1. In this study following effects were tested:
y=School achievement (GPA).
y=Abstract thinking level (Formal operations test score).

2. The relationships between the variables in the 3-level models?

Tested effects



Background variables
Gender, age

METHOD

SAMPLE:

9th graders from the capital area and Eastern Finland,
N=769, 51 classes, 7 schools.

MEASURES

1. School achievement

GPA (last report card, from the student register)

2. Formal operations:

Formula-test Hautamäki 1984; Hautamäki & al. 2002

(modified version of the original Science Reasoning Tasks, The Pendulum (Shayer et al, 1979) based on one of the Inhelder-Piaget identified formal schemata (Inhelder & Piaget, 1958) called The Formula I

Example of the items:

Comparison pair

driver	*car*	*tires*	*race*
Räikkönen	*McLaren*	*Michelin*	*Monaco*
Schumacher	*Ferrari*	*Michelin*	*Monaco*

Is it possible to conclude based on this information?

	no	perhaps	yes
effect of driver	*1*	*2*	*3*
effect of car	*1*	*2*	*3*
effect of tires	*1*	*2*	*3*

Russell, J. (1999). Cognitive development as an executive process—in part: A homeopathic dose of Piaget. *Developmental Science, 2*, 247–295.

3. Attention:

Computer-based

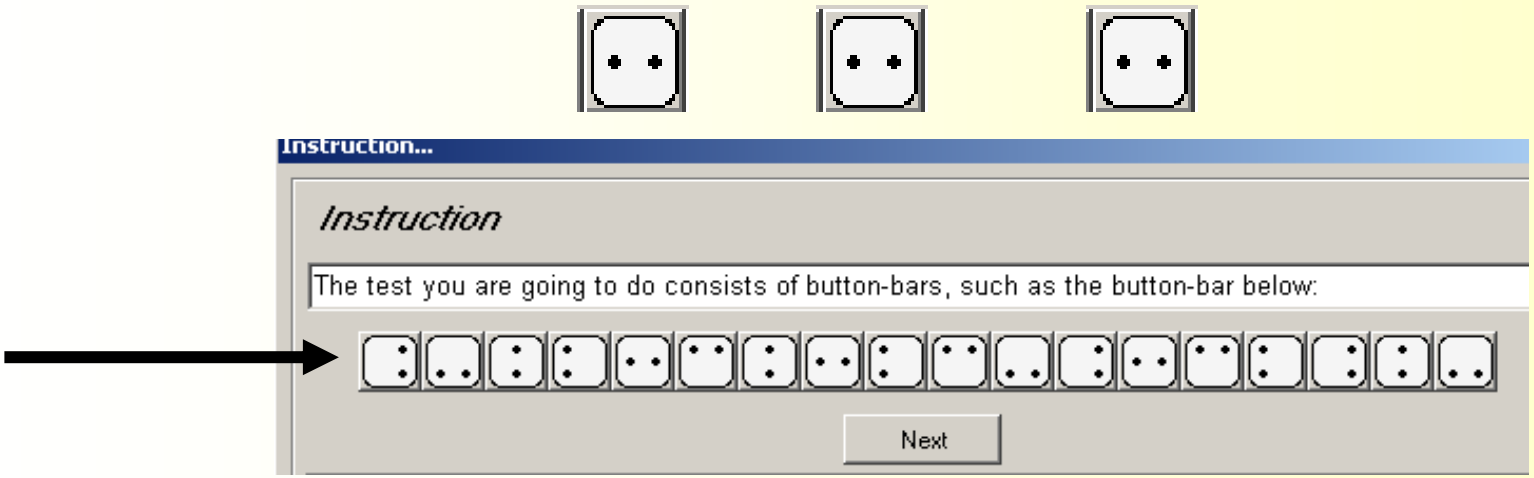
Attention Concentration Test (ACT)

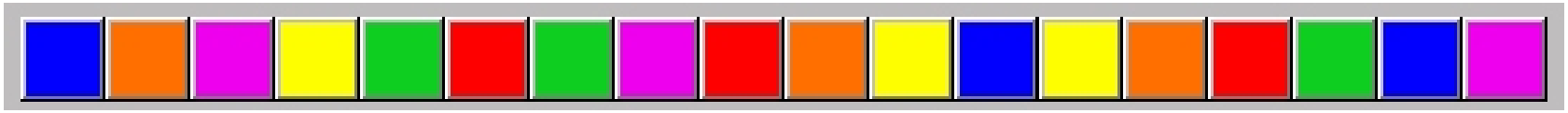
van der Ven, 2005

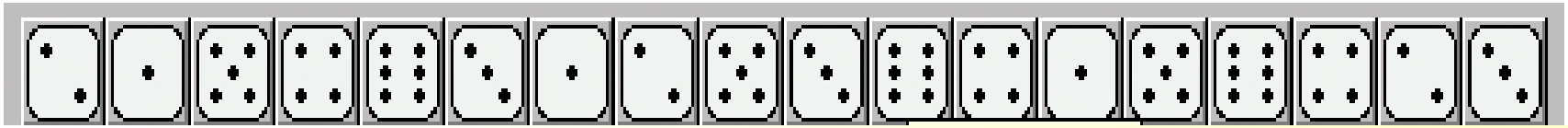
Basis´on the Inhibition theory. Prerequisites of the test:

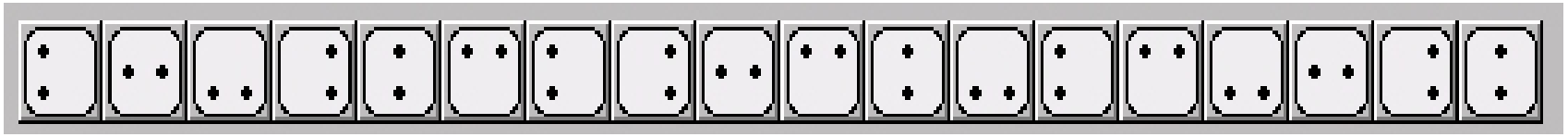
- Must be overlearned before the actual test
- Can be repeated as many times as needed to pass it

Especially taylored for basic and secondary education









Inhibition theory

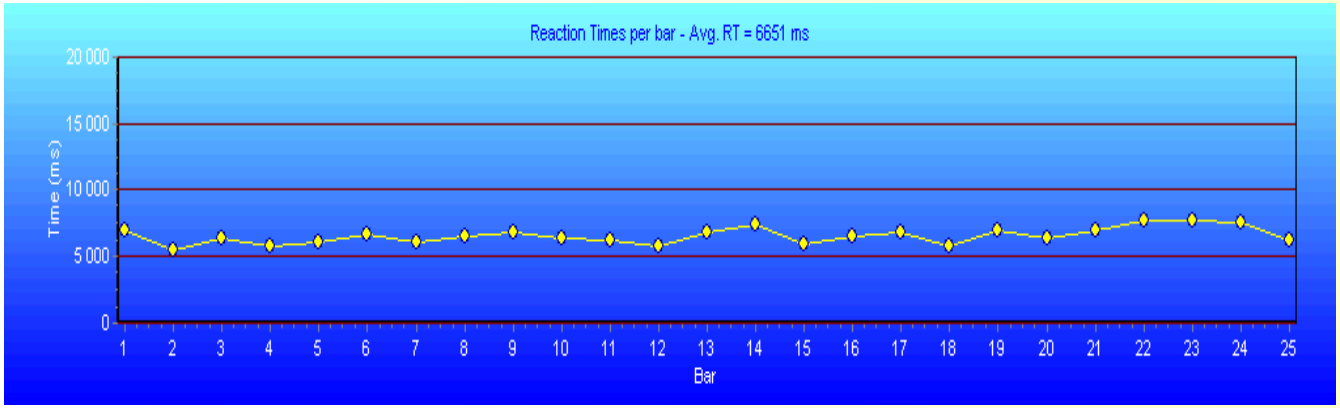
-continuously similar action causes adaptation in the signal mediating process

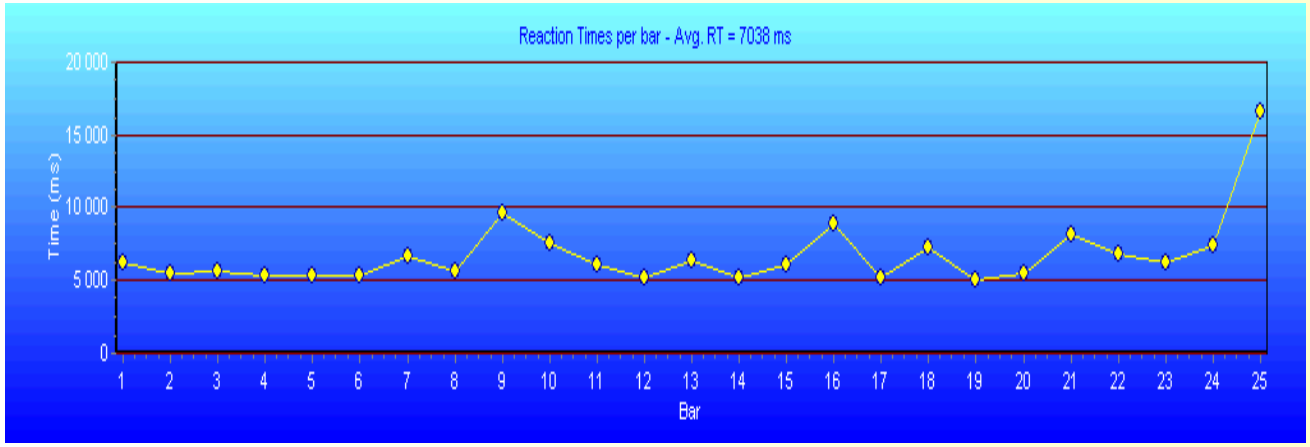
-shows in the test context as a slack of attention/getting tired

-identification of interindividual differences in the speed of adaptation and screen those students who have difficulties in working steadily, continuously and without mistakes.

ADHD: hasten, make more mistakes (Gumenyuk, V.; Korzyukov, O.; Escera, C.; *Hämäläinen*, M.; *Huotilainen*, M.; Häyrinen, T.; Oksanen, H.; Näätänen, R.; von Wendt, L.; *Alho*, K.. (2005) Electrophysical evidence of enhanced distractability in ADHD children. Preview. Neuroscience Letters, Vol. 374 Issue 3, p212-217)

ACT: passing the test as an approximate screening method?





Ven, A.H.G.S. van der. (2001). A Theoretical Foundation of Speed and Concentration Tests. In: Frank Columbus (Editor): *Advances in Psychology Research, Volume 4*, Hauppauge, NY: Nova Science Publishers.

Shmulevich, Ilya & Ven, A.H.G.S. van der (2002). An inhibition-based stochastic countable-time decision model. *British Journal of Mathematical and Statistical Psychology*, **55**, 17-25.

Ven, A.H.G.S. van der, Gremmen F.M. & Smit, J.C. (2005). A Statistical Model for Binocular Rivalry. *British Journal of Mathematical and Statistical Psychology*, **58**, 97-116.

Ven, A.H.G.S. van der & Gremmen F.M. (2006). A Statistical Test of the Beta Inhibition Model for Binocular Rivalry. *British Journal of Mathematical and Statistical Psychology* (In Progress).

Test conditions (2 hours per class):

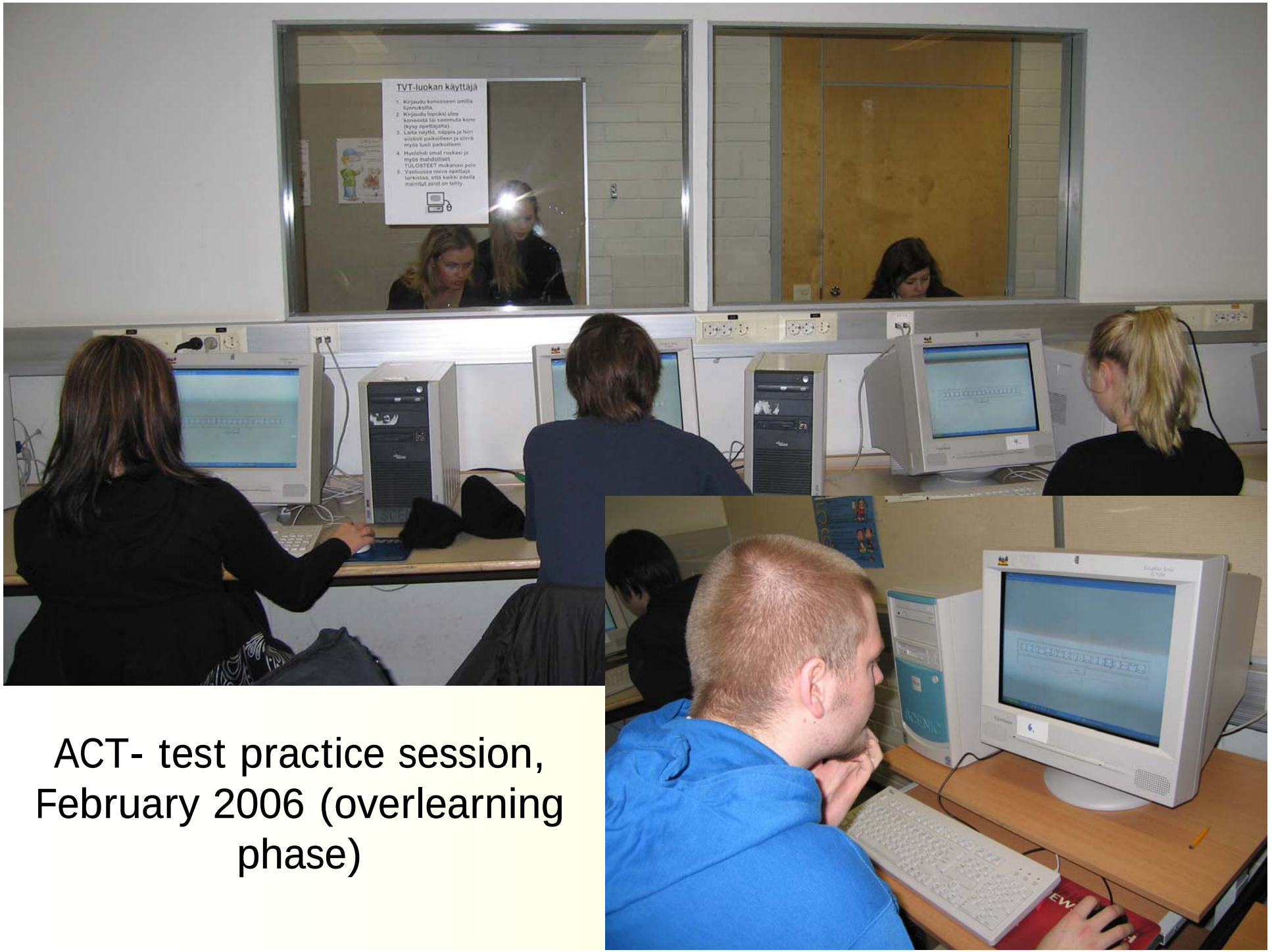
1. ACT: Practice in computer class till the test procedure is clear and the test-taking action is overlearned, (about 20 min).

   The test is implemented "individually". Only a few students in the computer class at the time. At least three tries to pass the test and at least three times to improve the gained error-free result till the point when the subject is satisfied.

   Degree of difficulty: More difficult parametres (25 rounds, random presence)

   Test persons: Two researchers, and graduate students.

2. Formal operation test and self-assessment after the ACT-test.



ACT- test practice session, February 2006 (overlearning phase)

THE RESEARCH OBJECTIVES:

1. What are the effects of class and school on school achievement, abstract thinking and attention concentration?
2. What is the relationship between abstract thinking, attention concentration and school achievement?
3. 3. What is the effect of gender or age-group on studied variables?

RESULTS:

Multilevel analysis (MLWin), 3 levels: individual / class / school

..clustering -> loss of independent observations -> risk of rejecting 0-hypothesis

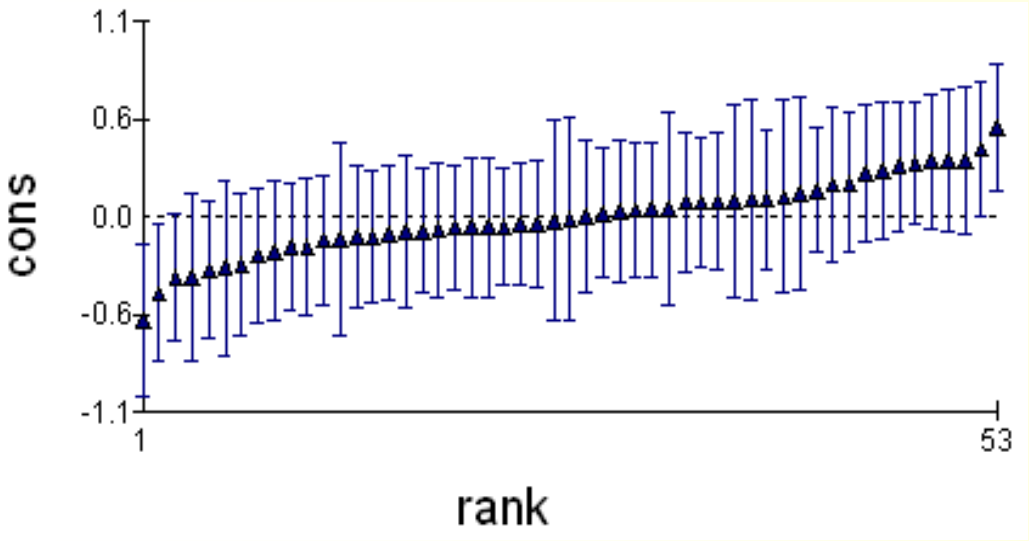
(Goldstein, 1995; Kreft & de Leeuw, 2006; Snijders & Boske, 1999; Steele, 2008)

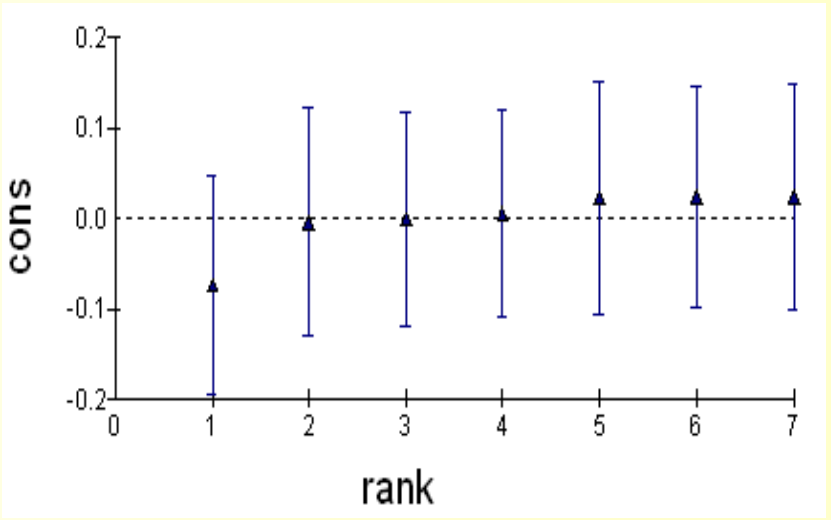
(A) School achievement, y=GPA

A1. Analysis of variance components, 0-model

Class level significant, explaning 9% (p<.01) of the GPA variance.

Schools homogenous,
School level explanation 1% (non-significant).



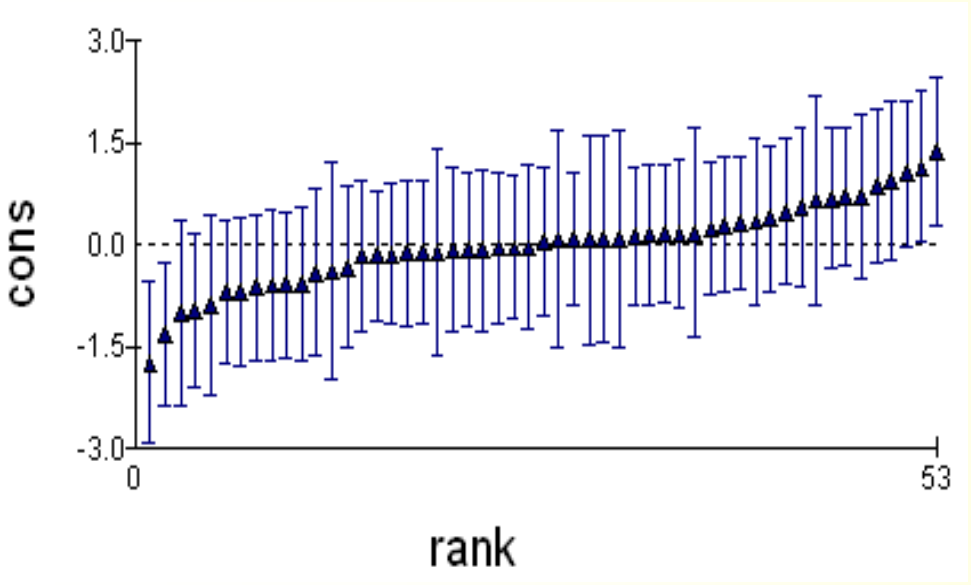


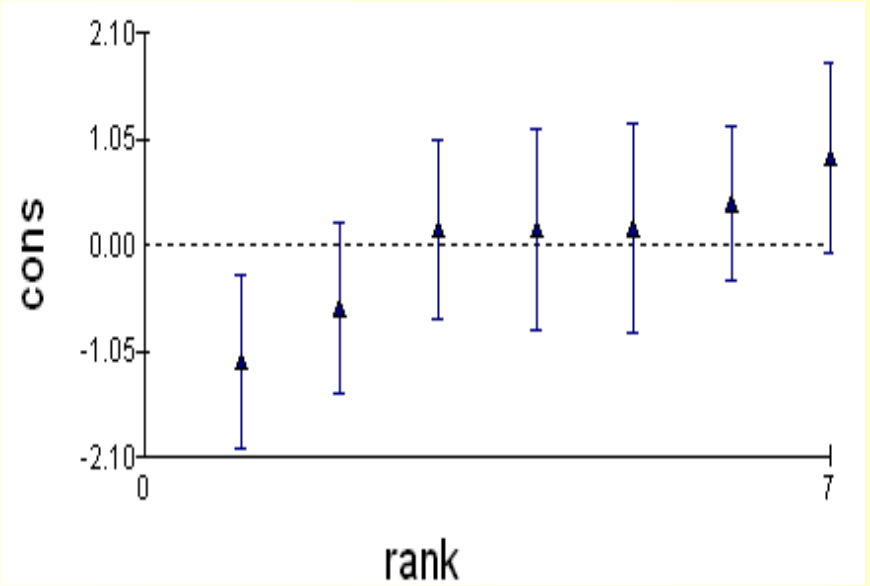
Class (left) and school (right) level residuals

(B) Abstract thinking, y=formal operations

B1. Analysis of variance components, 0-model

Both class and school level significant explainers of Formal operations variance; school level 7%, p<.001; class level 10%, p<.001.



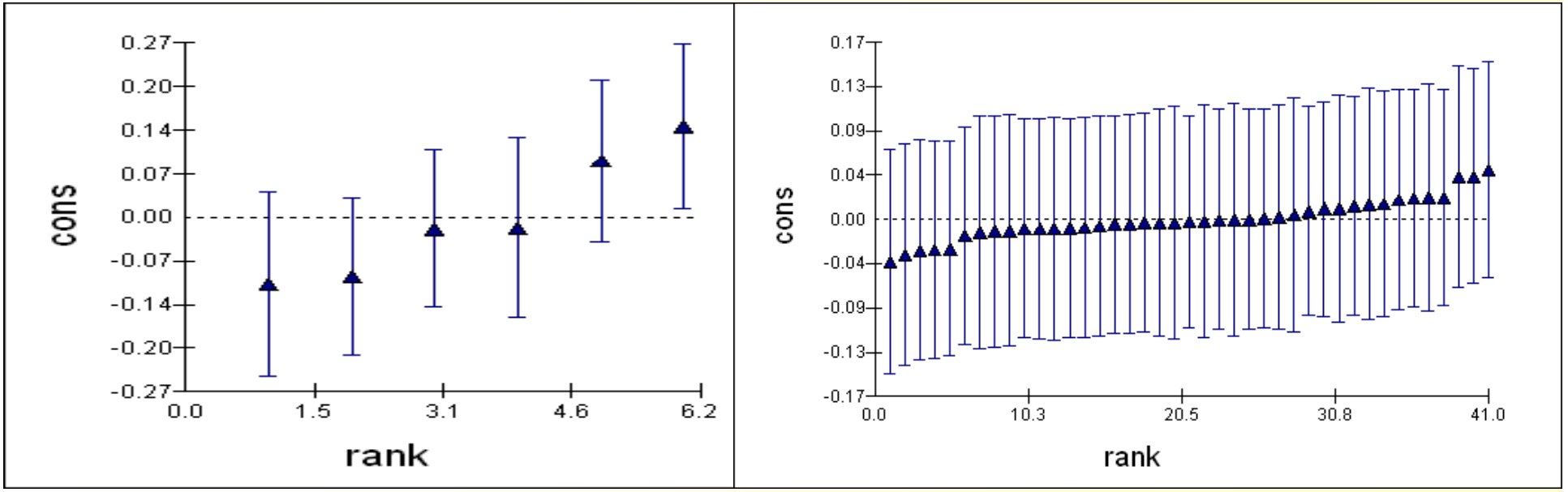


Class (left) and school (right) level residuals

(C) Attention, y=LnSqrtMSRMin20_07

D1. Analysis of variance components, 0-model

School level significant, explaining 5%, p<.05.
Class level significant, as well, explaining 1%, p<.05.



School (left) and class (right) level residuals

Gender and school achievement

- Strong effect: being a girl brings almost half of a number into GPA (grading in Finland from 4 to 10)
- Explanation in individual level 6%, class level 7% and school level 2%.
- Effect not homogenous, but varied somewhat by class

Agegroup and achievement

- By agegroups (9 groups based on quarter years): weak but significant effect, class level 4%, other levels less
- In the oldest groups lower GPA, but effect not fully linear

Formaalit operations and achievement

- Effect of formal operations strong especially in the class level, explanation 50%.
- School level explanation 25%
- Individual level explanation 20%.

- Thus, there are schools and classes in which the students think in a higher level of abstraction than in others

Attention and achievement

- Significant but weak effect on school achievement
- Effect faded away when formal operations were added into the model
- Passing the ACT test a strong explainer of achievement both in the class and school level.
- Only passing the test could be seen as an alternative screening method

Gender and formal operations

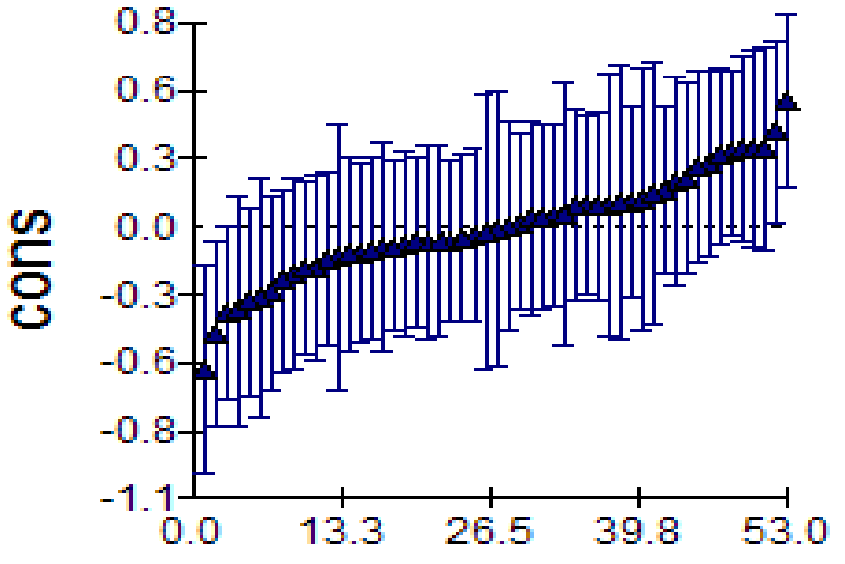
- No gender effect in the individual level, but a weak one in the class level
- The gender effect in the class level effect not homogeneous but varied by class
- In the oldest groups lowest scores

Ikäryhmä ja formaalit operaatiot

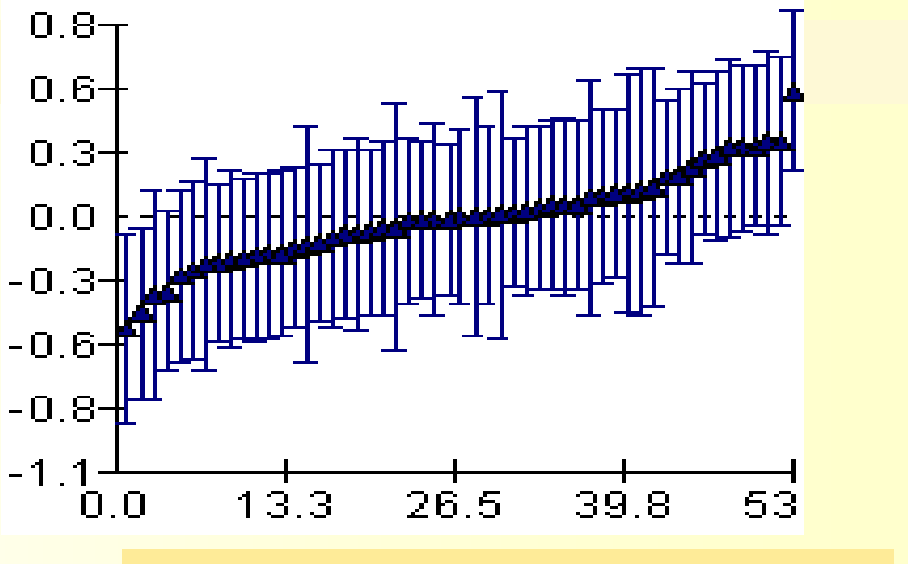
Attention and fromal operations

- Attention stronger explainer of formal operations than of school achievement;
  School level 6%, class level 4%, individual level 3%.

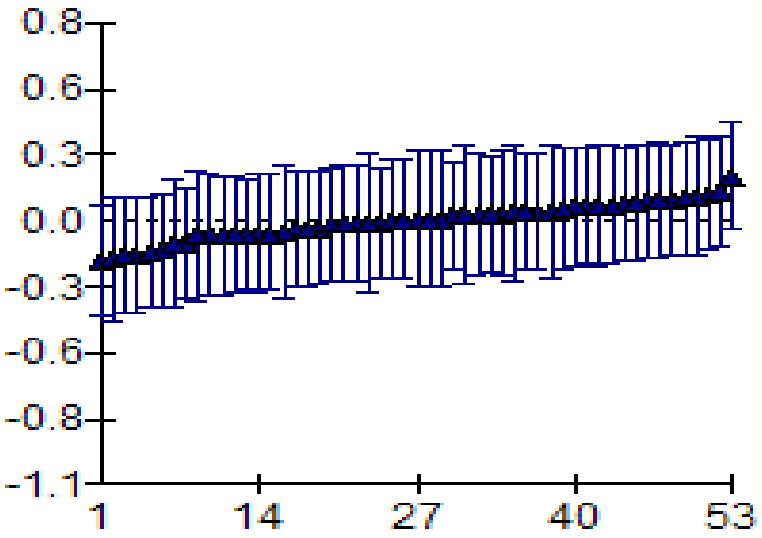
- Passing the ACT test explained 12 % of the formal operations scores in the school level, 8% in the calss level and 2 % in the individual level.



GPA residuals

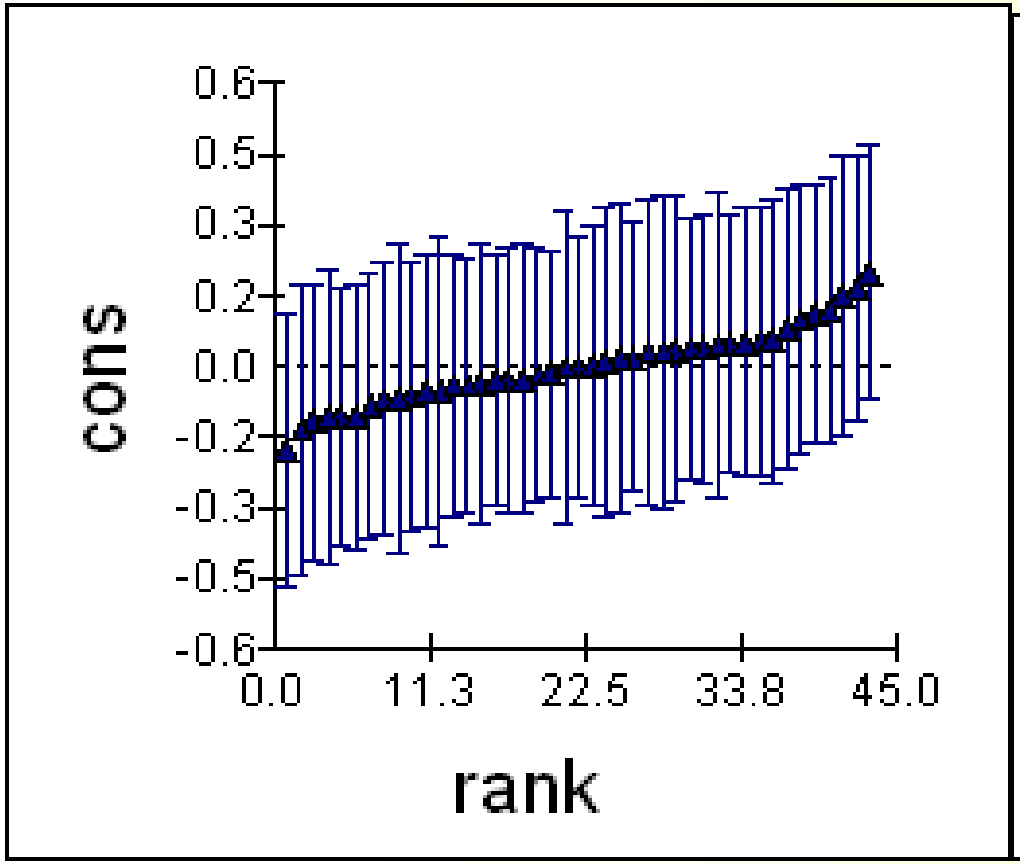


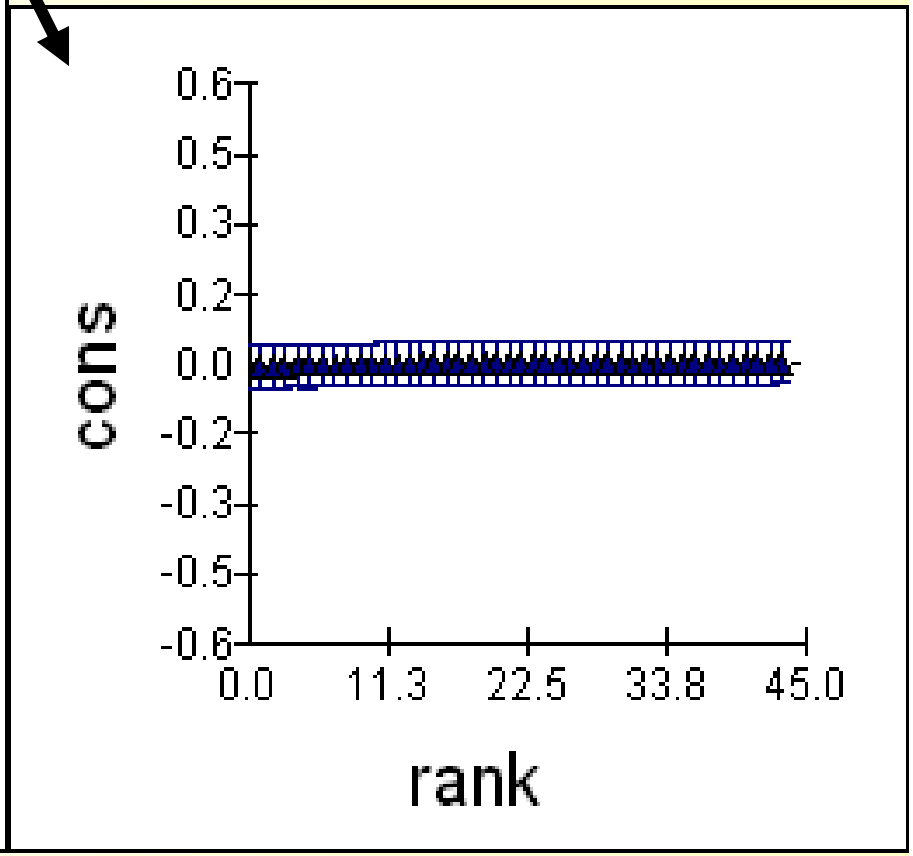
GPA & Fixed gender



GPA and fixed formal operations

The school achievement in the class level doesn't need more explainers, when passing the ACT test, gender and fromal operations are added…





GPA, 0-model

GPA and three explainers