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**Does an effective school teach
intelligence?**

Validity of Polish value-added indicators

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Introduction

- raw test scores as an inappropriate way of measuring school effectiveness due to their dependence on out-of-school factors
- educational value-added (EVA) indicators as much better measures of school effectiveness for policy purposes
- value-added methods of assessing schools' quality are being developed in many countries, i.a., in Poland

(Hattie, 2009; OECD, 2008)



Introduction - continued

Research project for development of value-added indicators:

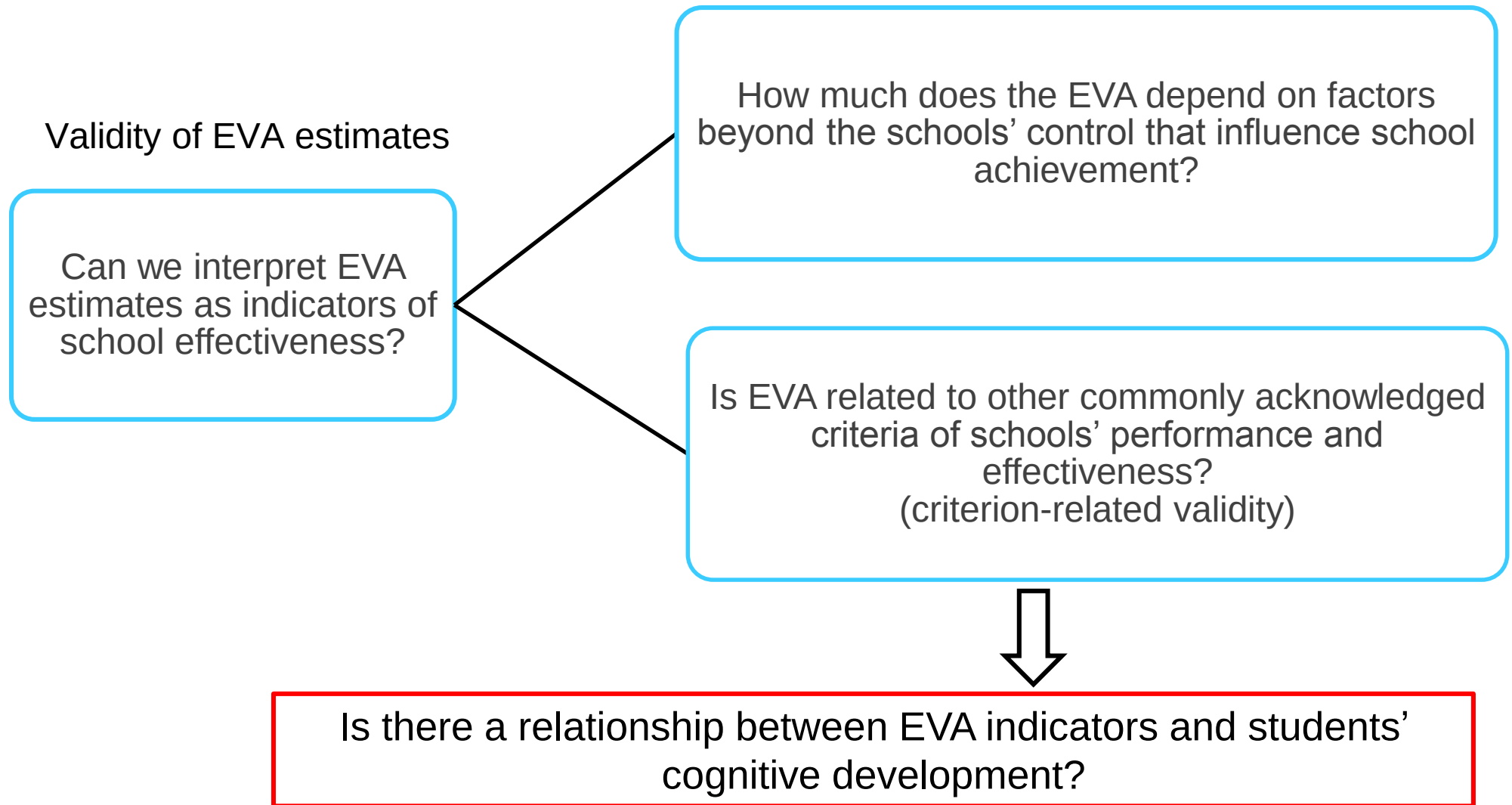
- Development of statistical models
- Publishing EVA estimates
- Quality check

Quality check of value-added indicators:

- verification of properties of exams used to compute EVA
- adequacy of the statistical model
- validity of EVA estimates



Research problem





Theoretical background

- improvement of cognitive functioning over childhood, puberty and early adulthood
- gains in intelligence in course of education
- schooling indicated as an important factor influencing intelligence
 - crystalized intelligence – for sure
 - fluid intelligence?
- School training in problem solving, emotional arousal management, encouraging to be persistent, etc. ---> better results in fluid intelligence tests?

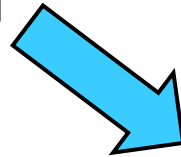
(e.g., McArdle, Ferrer-Caja, Hamagami & Woodcock, 2002, Ceci, Williams, 1997; Necka, 2012)





Idea of EVA estimation

Distribution of
school's predicted
outcome scores



95

105

Outcome scores



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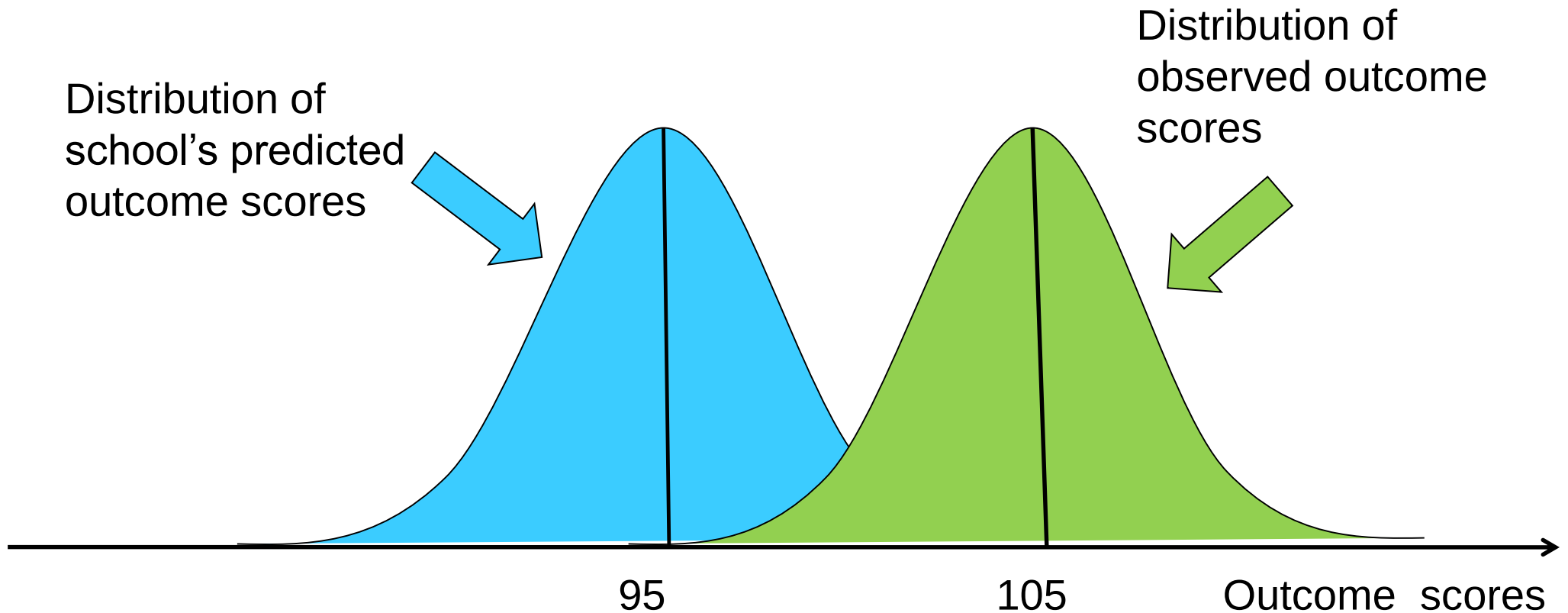
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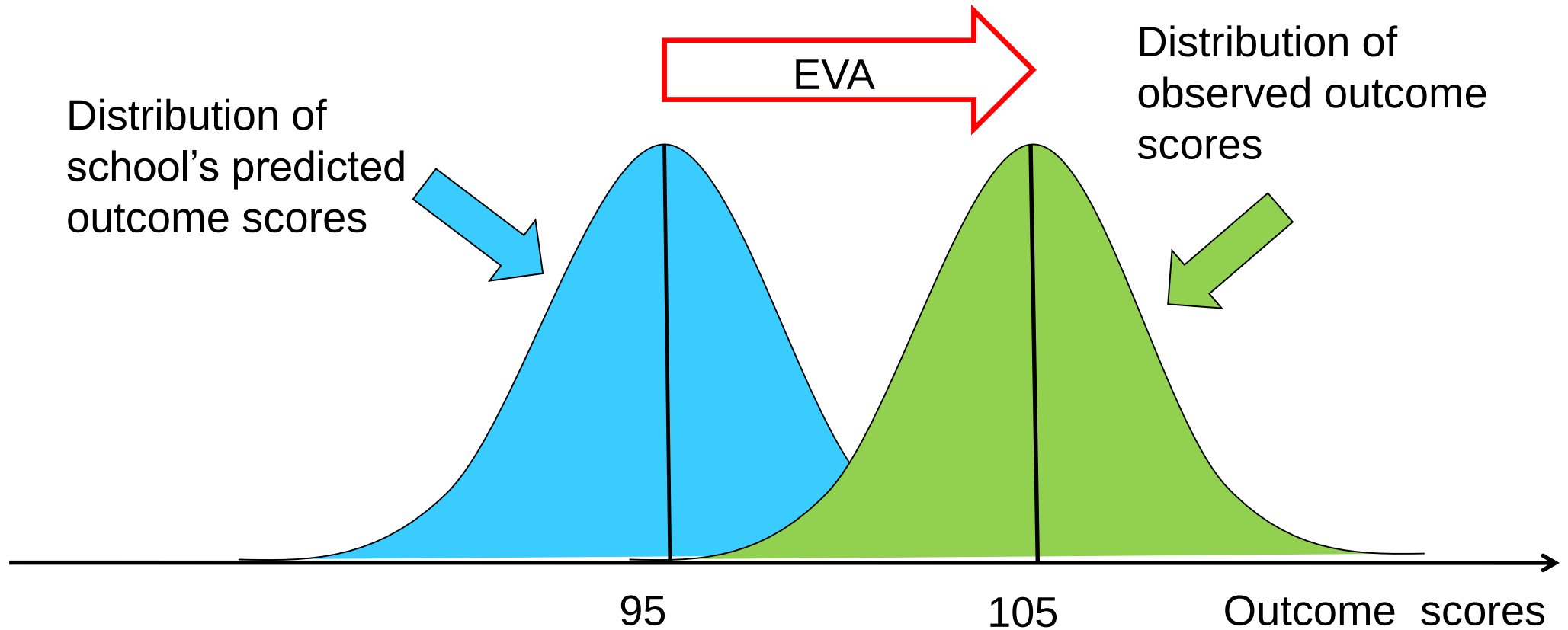


Idea of EVA estimation - continued





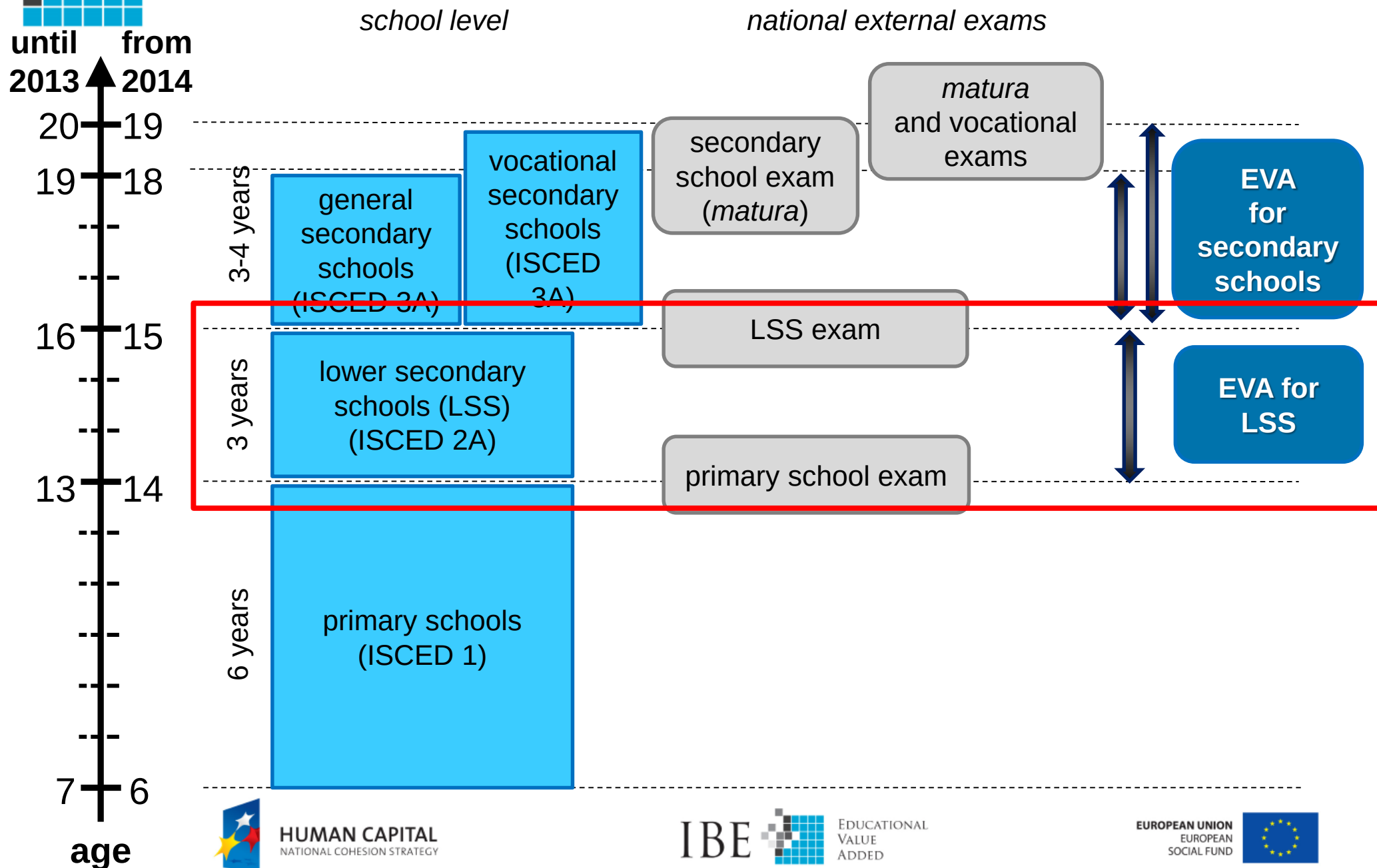
Idea of EVA estimation - continued



$$\text{Value added} = 10 \pm \text{CI}$$



National examination system in brief





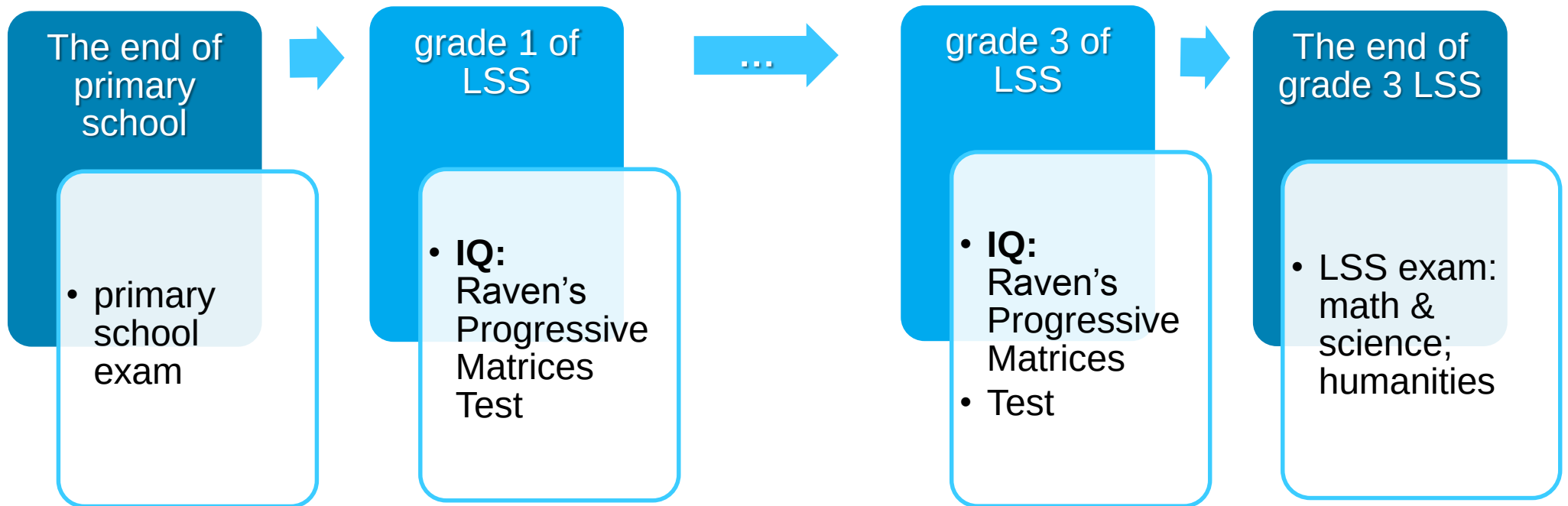
Data

- Educational Value-Added research project (www.ewd.edu.pl)
- Longitudinal study
- Random, nationwide sample
 - 150 lower secondary schools,
 - 291 classes,
 - 5 223 students;
- National external examination results
 - primary school exam
 - lower secondary school exam





Design & measures





Research problem

Is there a relationship between EVA indicators and students' cognitive development?

- Do schools differ in terms of students' intelligence gains?
- Are students' intelligence gains correlated with EVA indicators?



Analysis & results

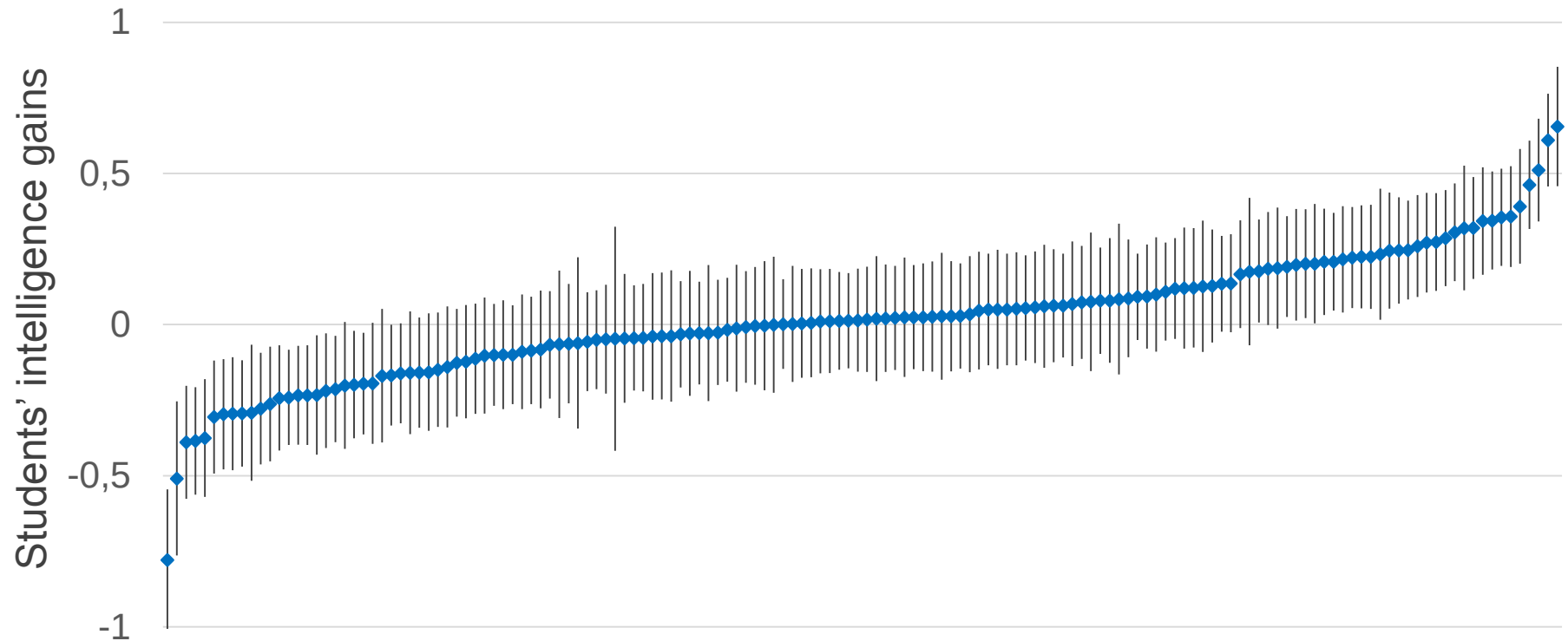
- Do schools differ in terms of students' intelligence gains?
 - Estimation of students' intelligence levels in 1st and 3rd grade of LSS
 - 2PL IRT model
 - two-level random effect regression model
 - 3rd grade IQ regressed on 1st grade IQ
 - variance of random effects on 1st and 2nd level as estimates of within- and between-school variance of students' intelligence gains

$$\begin{array}{c} \text{3rd grade IQ level} \longrightarrow Y_{ij} = \gamma_{00} + \gamma_{01} X_{01j} + u_{0j} + r_{ij} \\ \begin{array}{ccccc} \nearrow & \nearrow & \nearrow & \nearrow & \nearrow \\ \text{intercept} & \text{regression coefficient} & \text{1st grade IQ level} & \text{school level random effect (mean relative IQ gains)} & \text{student level random effect} \end{array} \end{array}$$



Analysis & results - continued

Do schools differ in terms of pupils' intelligence gains?



Mean gains of students' intelligence in schools with 95% confidence intervals

Between-school variance: **14,5%**



Analyses & results - continued

Are students' intelligence gains correlated with EVA indicators?

- Relative intelligence gains
 - Bayesian predictions of random effects at the school level
- Educational value-added:
 - two-level random effect regression model
 - LSS exam scores regressed on primary school exam, gender and learning disability
 - Bayesian predictions of random effects at the school level
 - two indicators: math & science, humanities

LSS exam $\rightarrow$

$$Y_{ij} = \gamma_{00} + \sum_{n=1}^N \gamma_{0n} X_{0nj} + u_{0j} + r_{ij}$$

intercept $\rightarrow$ γ_{00}

vector of students' characteristics
(primary school exam, gender,
learning disability) $\rightarrow$ $\gamma_{0n} X_{0nj}$

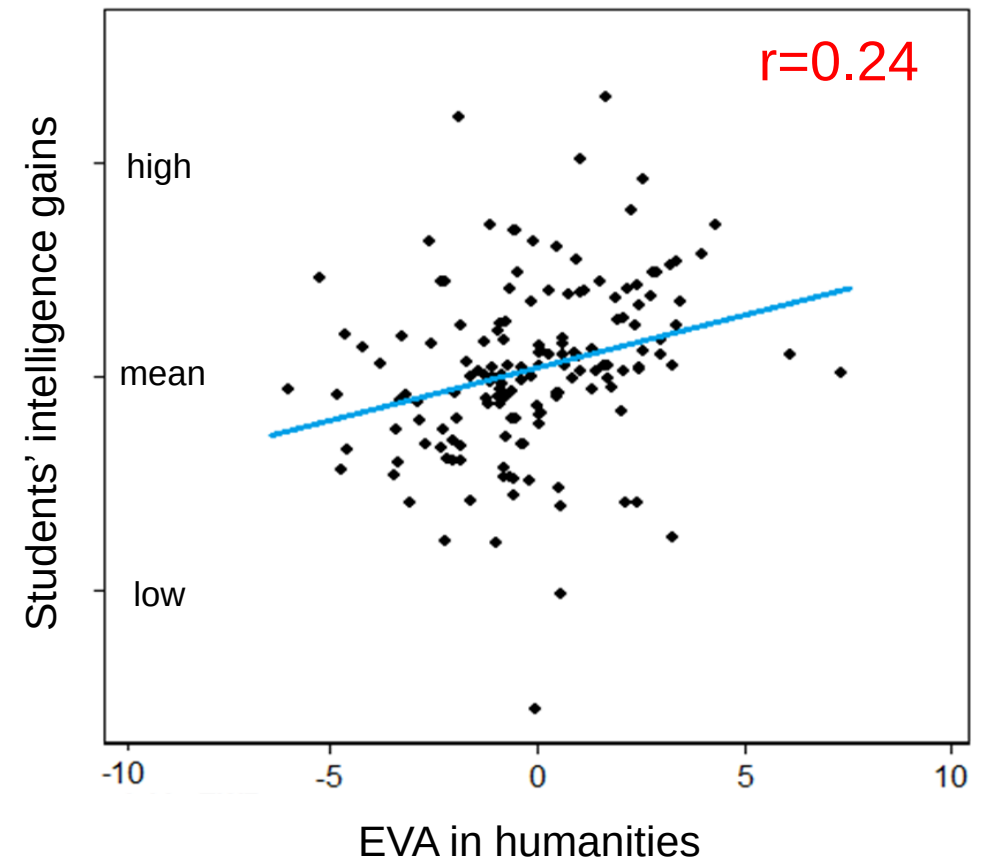
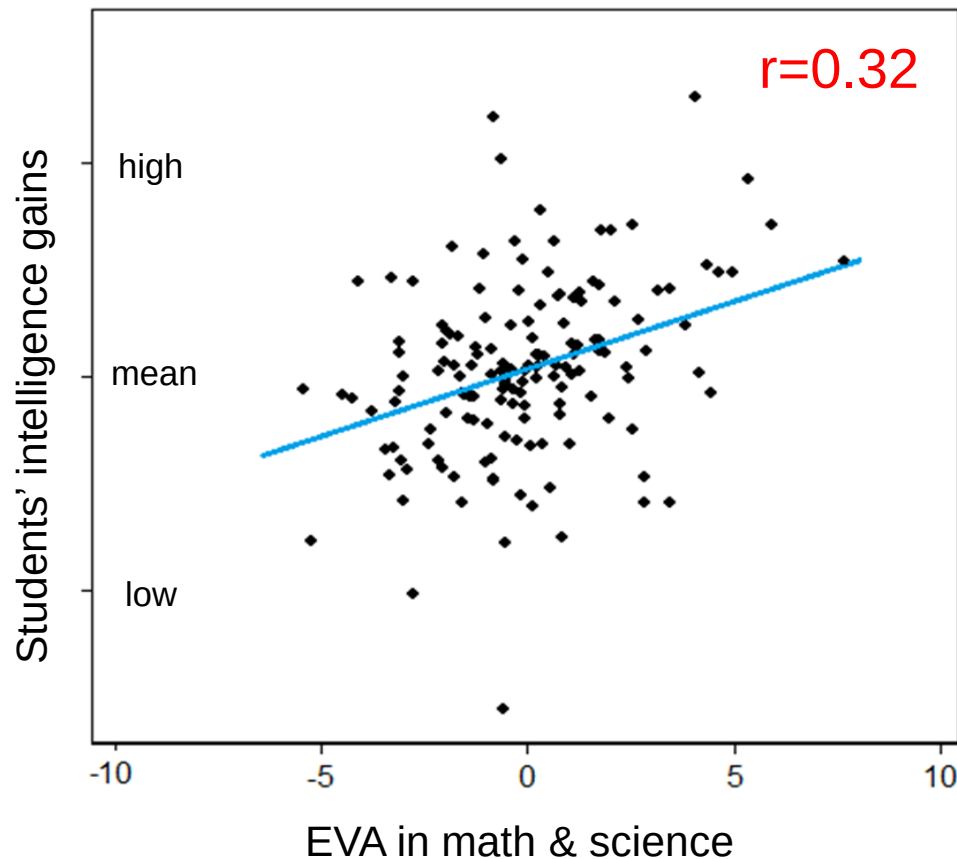
school level
random effect
(EVA) $\rightarrow$ u_{0j}

student level
random effect $\rightarrow$ r_{ij}



Results - continued

Are students' intelligence gains correlated with EVA indicators?





Results - continued

- However some analyses suggest that EVA indicators are genetically influenced (Haworth, 2011).
- Do we observe a spurious correlation?

Correlation coeff.	Math & science	Humanities
Simple	0.32	0.24





Results - continued

- However some analyses suggest that EVA indicators are genetically influenced (Haworth, 2011).
- Do we observe a spurious correlation?

Correlation coeff.	Math & science	Humanities
Simple	0.32	0.24
Partial	0.28	0.20



Summary and conclusions

- ☐ Polish schools differ in size of students' intelligence gains.
- ☐ There is positive relationship between intelligence gains and EVA.
- ☐ Partial confirmation of validity of EVA for Polish lower secondary schools.
- ☐ More criteria of validity are needed
- ☐ It is probable that an effective school teaches intelligence.



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Thank you for your attention!

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