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Relationship of Problem Solving to Literacy

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The Relationship of Problem-Solving in Technology-rich Environments to Literacy and Numeracy: Insights from PIAAC

Jan-Eric Gustafsson

University of Gothenburg and University of Oslo

General comments

- Interesting and impressive demonstrations what can be achieved with regression techniques and massive data
- The PIAAC comparative cross-sectional design with multiple age cohorts offers rich possibilities for investigating effects of educational and social policies, even though there also are great analytical challenges



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Some concerns and issues

- Basic issues:
 - The PVs are observed variables influenced by errors of measurement
 - How much reliable variance is there in PS-TRE to account for?
 - How much bias is there in estimates of regression coefficients?
 - Heavy imputation of scores based on complex models may lead to biased analysis results
 - Missing data due to partial non-response causes bias and other problems



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Some concerns and issues

- Measurement issues:
 - The Literacy, Numeracy and PS-TRE scales are complex measures of competencies with incompletely known measurement characteristics
 - Standard techniques are not easily applied to investigate measurement issues
 - Should PS-TRE be treated as a dependent or an independent variable, or should Literacy, Numeracy and PS-TRE all be treated as dependent variables related to one or more latent independent variables?



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Main discussion question

- Can the PIAAC proficiency scales be related to what is known about the structure of cognitive abilities?
 - If that is so, connections could be made to a rich body of empirical research and theorizing



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Crystallized (Gc) and Fluid intelligence (Gf)

- Gc
 - Verbal comprehension, vocabulary, achievement in different domains of learning
 - Increases with education and throughout life
 - Do Literacy and Numeracy reflect Gc?



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Crystallized (Gc) and Fluid intelligence (Gf)

- Gf
 - Complex problem solving with new tasks, often nonverbal
 - Increases up to about 25 years of age, and declines thereafter
 - Plasticity, education being an influential factor
 - Correlates perfectly with g within groups who have had equal opportunity to learn what is tested
 - According to Cattell's Investment theory, Gf is a causal factor in development of individual differences in knowledge and skills
 - Does PS-TRE reflect Gf? Does Numeracy reflect Gf?



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A one-factor model (Canada data)

| Standardized factor loadings | | Explained variance |
|------------------------------|------|--------------------|
| | G | |
| Literacy | 0.97 | 0.94 |
| Numeracy | 0.90 | 0.81 |
| PS-TRE | 0.87 | 0.76 |

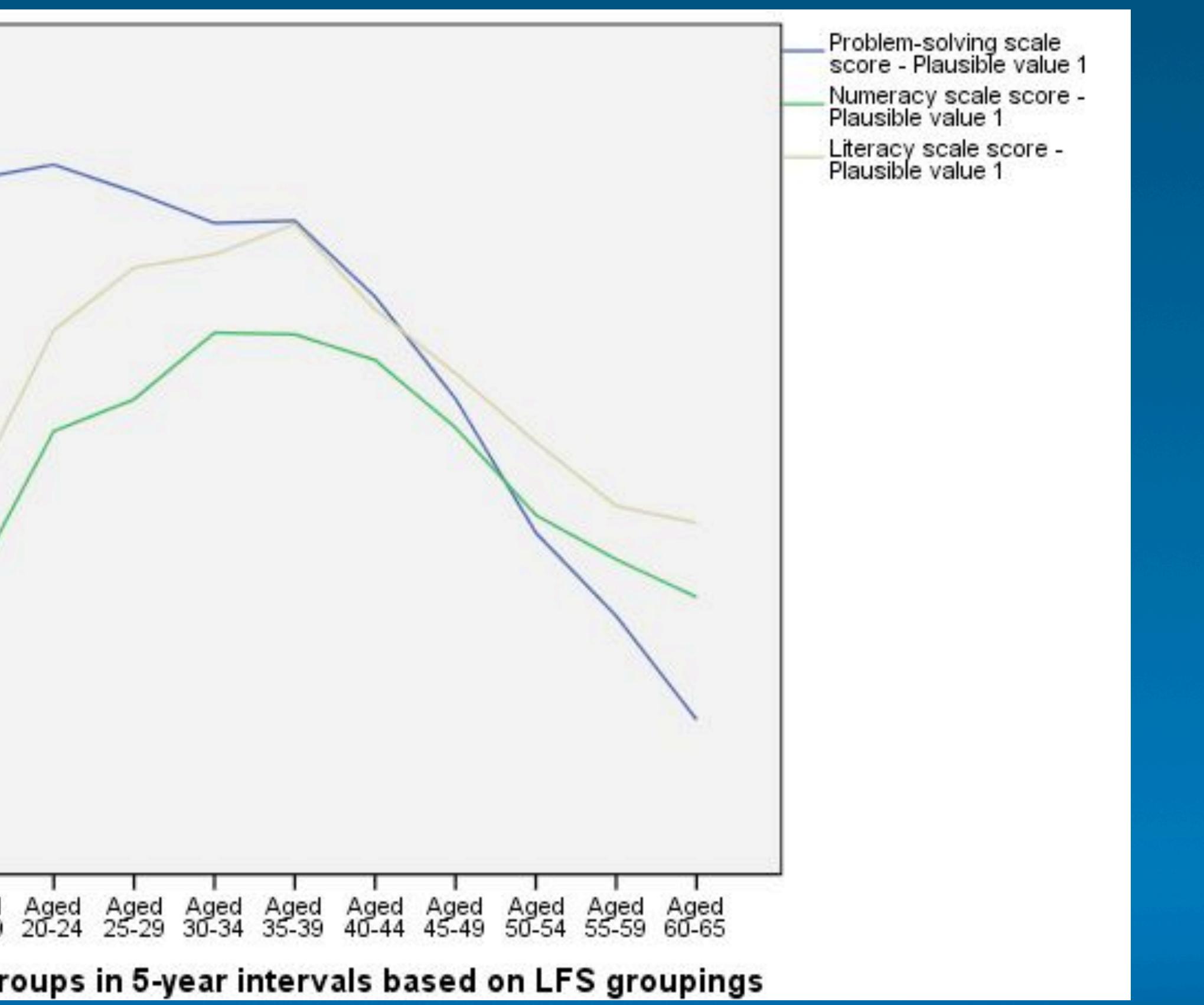
Note. Model estimated with the Mplus MLR estimator, case weights and missing data option



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Proficiency related to age



Analyses within age groups

- The different age groups have had different opportunity to learn the skills measured in PIAAC. If we only look at relations within age groups we would expect higher relations between Gf-measures on the one hand and Gc-measures on the other, than when we analyze all age groups pooled together.

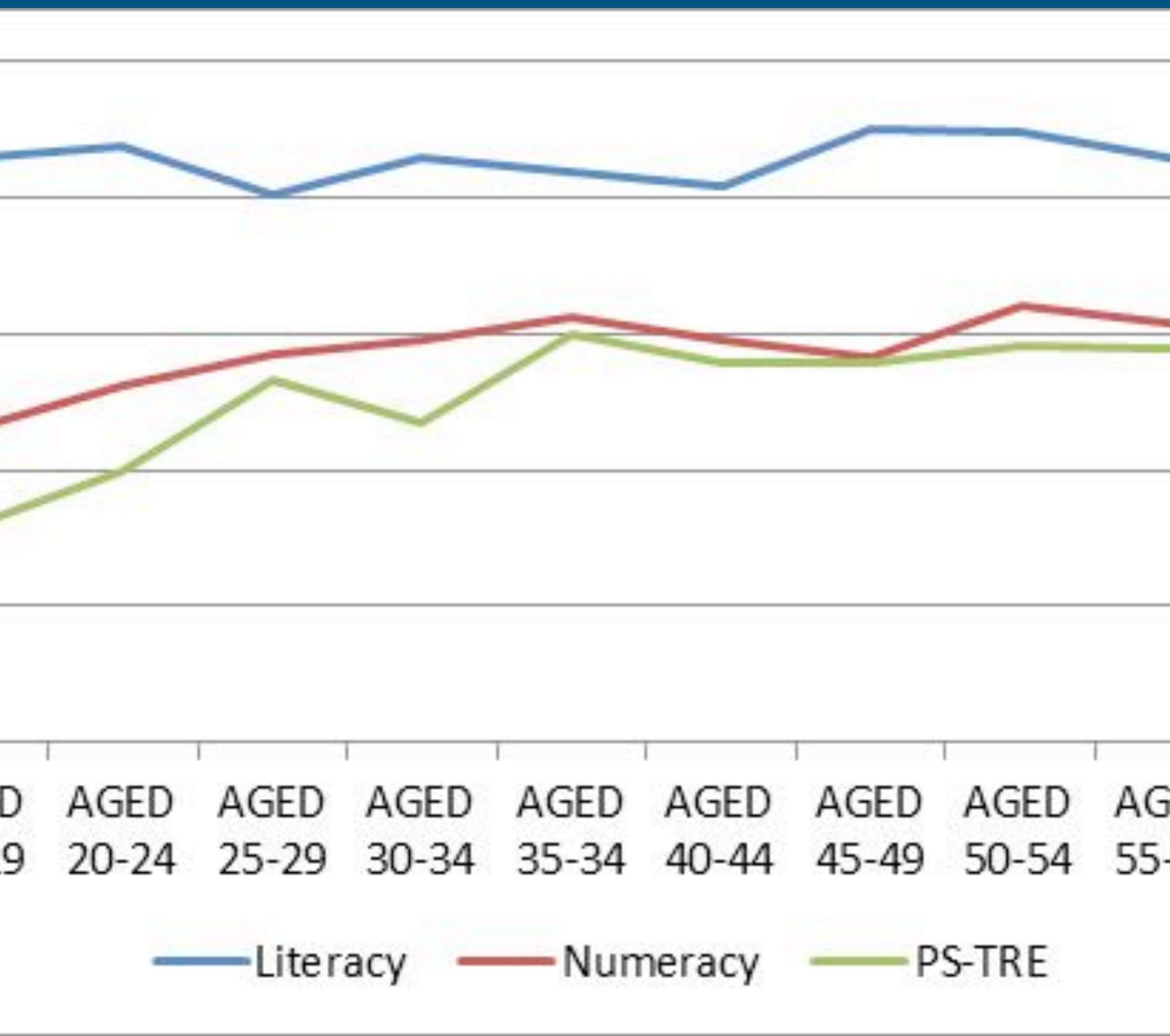


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Factor loadings in separate one-factor models for different age groups

- The loadings for Numeracy and PS-TRE increase as a function of age. The mean of PS-TRE loadings is somewhat higher than in the model with pooled age groups (0.89 vs 0.87)



Conclusions

- The pattern of development of the means of the proficiency scales across age groups supports the interpretation that PS-TRE partially reflects Gf
- The pattern of development of the factor loadings provides some support that PS-TRE and Numeracy partially reflect Gf
- To get further insight into the measurement properties of the three scales it will be necessary to get closer to the content and processes of the items



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Thank you for your attention