Time-economical assessment of intelligence as predictor variable for academic learning: *Is speeded reasoning enough?* [hint: no!]

Peter Edelsbrunner
ETH Zurich

Test of Relational Reasoning (TORR)

Alexander, Dumas et al., 2015; Goldwater & Schalk, 2016; Holyoak & Lu, 2021; Jastrzębski et al., 2023; Kalra & Richland, 2022

Analogy (10 min)

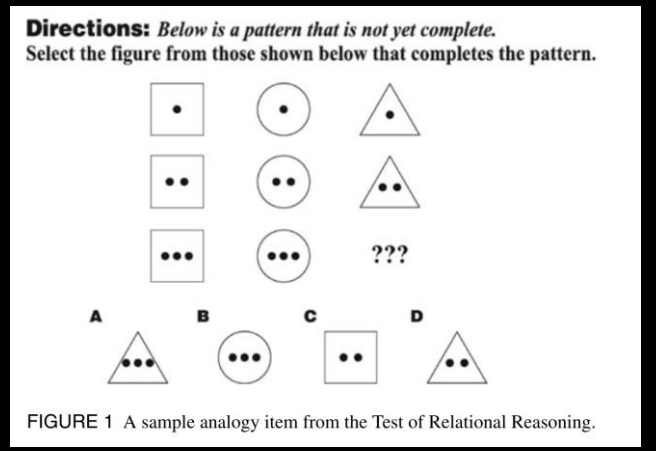

FIGURE 1 A sample analogy item from the Test of Relational Reasoning.

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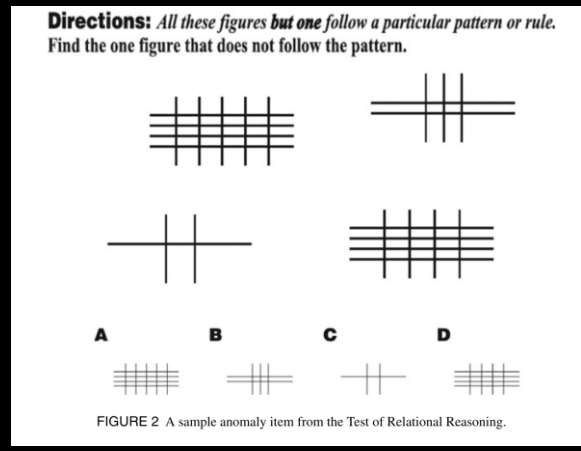
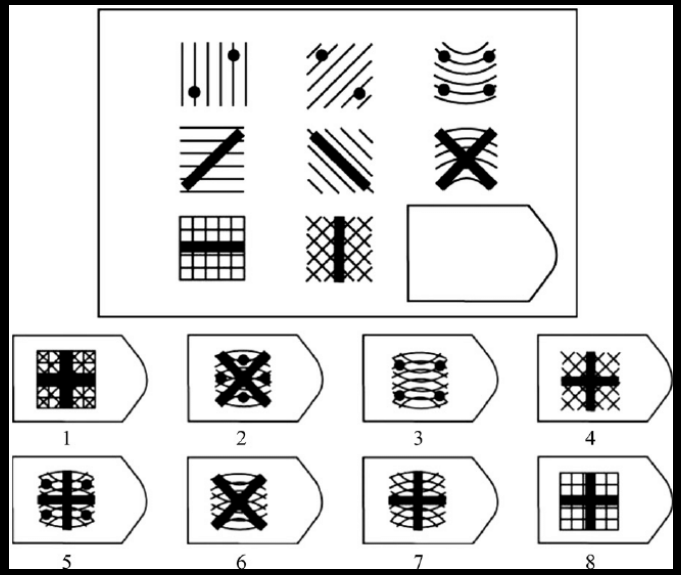


FIGURE 2 A sample anomaly item from the Test of Relational Reasoning.

Raven APM (**40 min; 20 min; 7 min**)

Hamel & Schmittmann, 2006; Poulton et al., 2022



KFT number series (**10 min**)

Heller & Perleth, 2000

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mini-q
Baudson & Preckel (2015)

64 items
3 minutes
Speeded reasoning

	TRUE	FALSE
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There are no rules to be learned

Speeded reasoning (Baudson & Preckel, 2016)

Analogical mapping of figural and verbal relation ← But it's really trivial!

Does the figural relation match the verbal relation? ← This is also really trivial!

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[a] Department of Psychology, University of Mainz, Mainz, Germany
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«Working memory capacity accounted for the majority (54%) of the association between test performance and general cognitive abilities, whereas individual differences in processing speed did not contribute to this relationship»

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Measure of fluid intelligence (Pollet & Schnell, 2017)
Measure of mental abilities (Baltes & Diehl, 2018)
Measure for cognitive abilities (Meuer & Imhoff, 2021)

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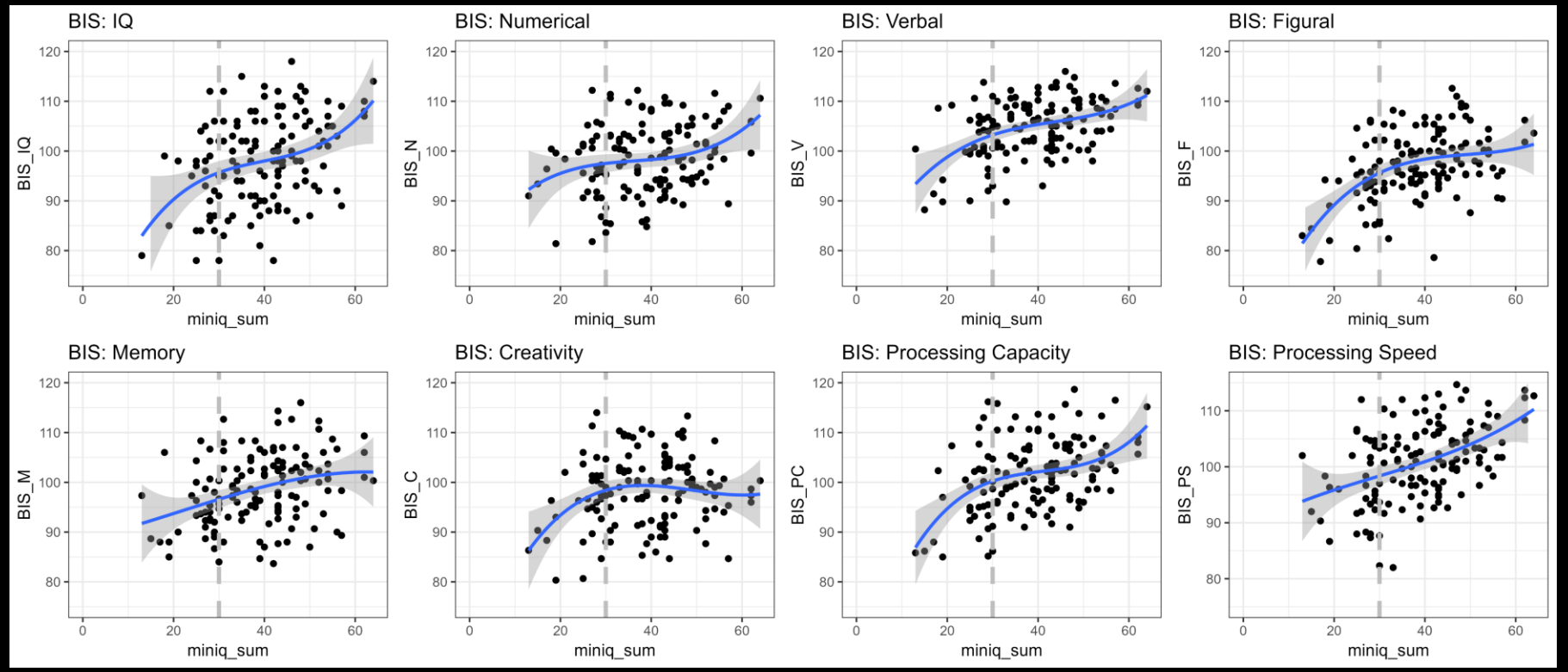

r = .33 *r* = .12 *r* = .41 *r* = .46

- Stronger **figural** and **verbal** than numerical components
- There are **quadratic relations** with most intelligence facets (but speed)
- Relations in the **upper range** are **less pronounced**

Validity: Correlations of the mini-q
Evidence from prior studies

Convergent:

Intelligence structure test: *r* = .25/.47 (Weise et al., 2024) <- *less speeded measure*

Complex problem solving: *r* = .18/.28 (Gigl et al., n.d.) <- *power measure*

GPA: *r* = .07/.25 [parallel version] (Weise et al., 2024) <- *eat this! (Meta-analytic IQ/SA: r = .54; Roth et al., 2015)*

Age: *r* = -.29/-.45/-.50 (e.g., Schubert et al., 2023)

Memory updating: *r* = .47 (Schubert et al., 2023) <- *interesting! Makes sense – so many items in so little time!*

Reaction time measures (working memory; Posner): *r* = -.35 - -.45 (Schubert et al., 2023) <- *higher than with accuracy!*

The triangle rejects the square
The circle prefers the triangle
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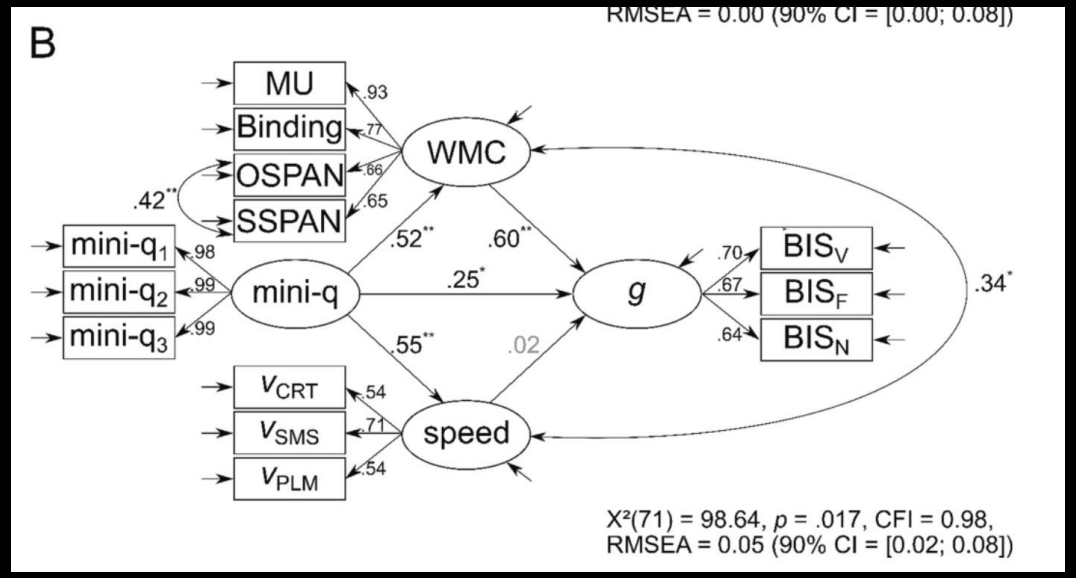
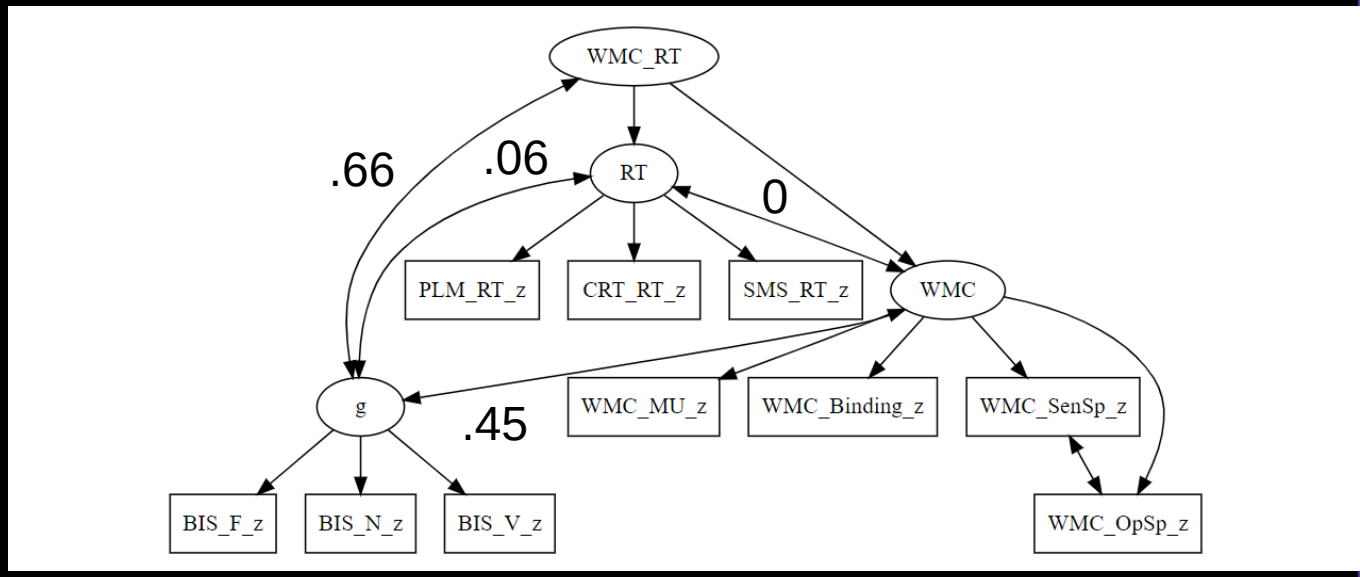
The mini-q measures a lot of **processing speed**, **updating, attention**, and rather **little G**, **complex problem solving**, or **GPA-related abilities**

*«**Working memory capacity accounted for** the majority (54%) of the **association between test performance and general cognitive abilities**, whereas individual differences in processing **speed did not contribute** to this relationship»*



Re-analysis with common WMC/RT-factor: «Working memory capacity and processing speed both together accounted for 44% for variation in cognitive abilities and had similar relations with the mini-q



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Odd/even: r = .96/.99 (Weise et al., 2024)

Alpha = .94/.96 (Weise et al., 2024)

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Retest-reliability should be used for reliability estimation

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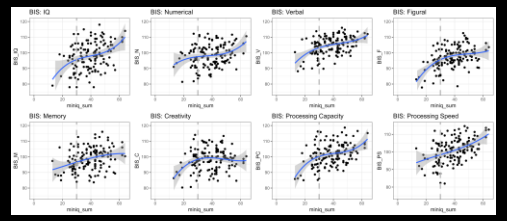

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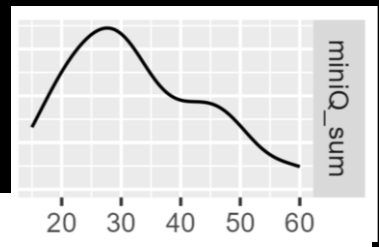

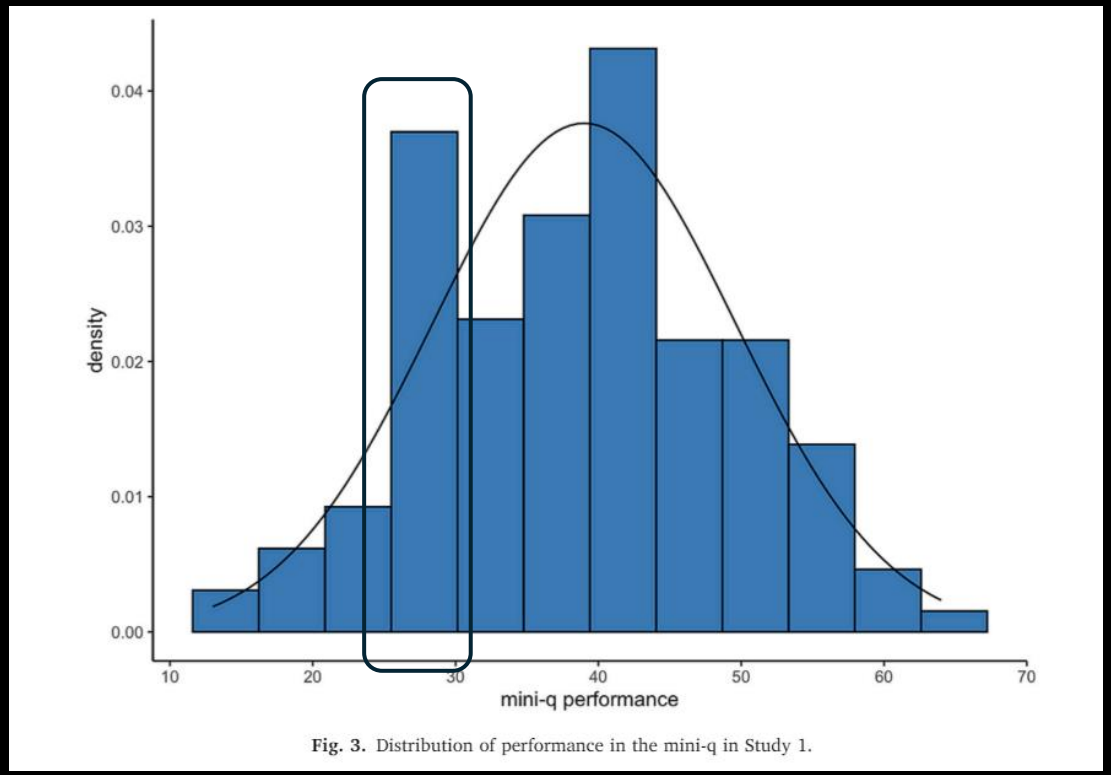

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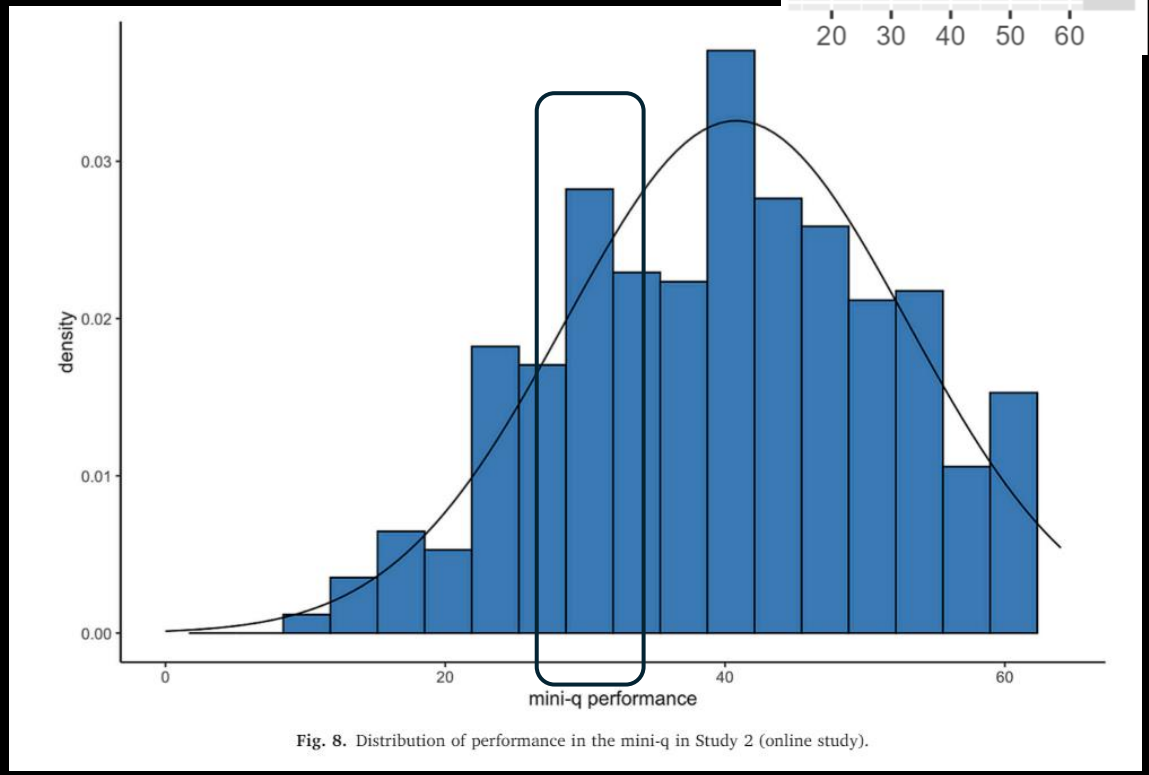

Fig. 8. Distribution of performance in the mini-q in Study 2 (online study).

Bi-/multimodality: Breakdown after speed is the only factor? Item wording effects?

Different strategies? *«I first looked at the figures, but for the later items I started with the sentences»*

An alternative proposal: Test of Relational Reasoning (TORR; Alexander, Dumas et al., 2015)

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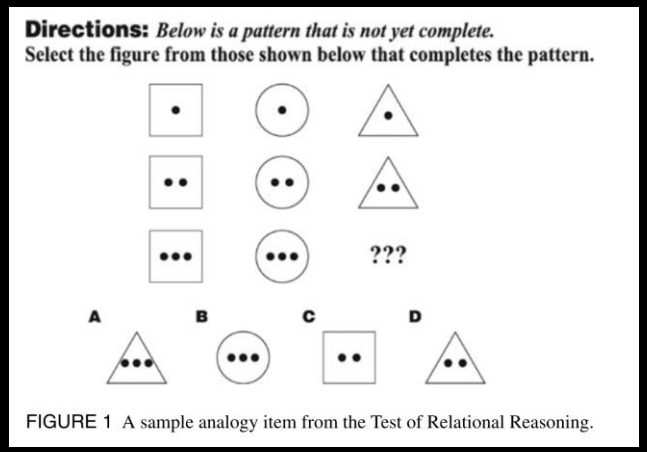

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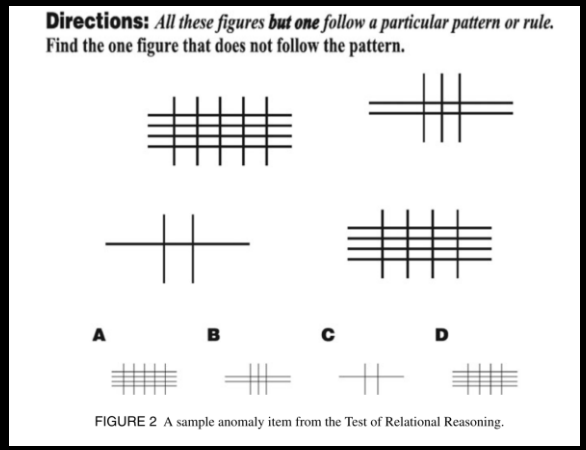

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N = 98 high school students

Representational competence

Conceptual Knowledge

Mastery goal orientation

	Anal_mean	Anom_mean	miniQ_sum
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KWTPre	Corr: 0.264	Corr: 0.281	Corr: 0.255
KWTPost	Corr: 0.223	Corr: 0.298	Corr: 0.189
Note	Corr: -0.070	Corr: 0.240	Corr: 0.037
Model_mean	Corr: 0.201	Corr: -0.070	Corr: -0.080
Mastery_mean	Corr: 0.147	Corr: 0.028	Corr: 0.389*

It might be a worse indicator of academic learning than other short reasoning scales

It might draw more upon current achievement motivation (Freund et al., 2015)

Conclusions

- The mini-q correlates with intelligence only in the lower range; it is not a proxy of intelligence

- The mini-q measures mostly processing speed, maybe attention, updating

- Its reliability is maybe around .80 but yet unknown – retest-studies are required

Hypotheses for future research

The mini-q is multidimensional

The mini-q draws on different strategies

Selecting good strategies might be the only intelligent component

The mini-q draws on inhibition (inverse items) /updating

The mini-q draws on current achievement motivation

It might not be the right tool to get a reliable and valid covariate in predicting complex cognitive states and traits

Not everything that requires **some kind of reasoning** measures **intelligence**

Don’t Waste your Time Using the miniQ: It is not an Effective Proxy of Intelligence or Predictor of Academic Learning

Reaction time tasks: Obviously good correlations

WMC and miniq still correlate .34 even after contr
miniq! And their combined variance (i.e., bifactorg
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Important, well-conducted study.

But I disagree with some interpretations for reaso

First:

Second:

Third:

Scatter plots iwth BIS C and F: Wow! Extremely qu

Short forms always been interest

- Raven etc.
- Or just a numeric scale (e.g., number series
- Or just a spatial (rotation) or verbal (analogies) scale, or cubes or smth for fluid stuff mostly
- Alternative approach/idea: Baddeley.
- Mini-q:
- Show 2 quick examples
- What does this measure and what is it good for?
- Overview of available studies: First studies did this and that.
- Recent study: First bigger investigation into… [summarize]
- Let's see:
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Social motivation: .06
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Communication and reciprocity: .11

Victim sensitivity: .20 (Meuer & Imhoff, 2021)

Moderately negative with (Pollet & Schnell, 2017):
Age, subjective well-being, religiosity, spirituality, practicality, harmony, self-compassion, demands and appreciation in school experience, meaningful work, joy of working

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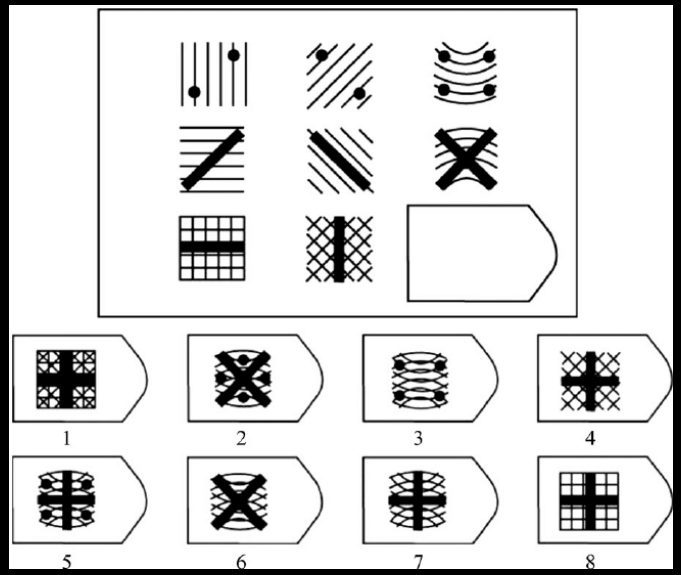

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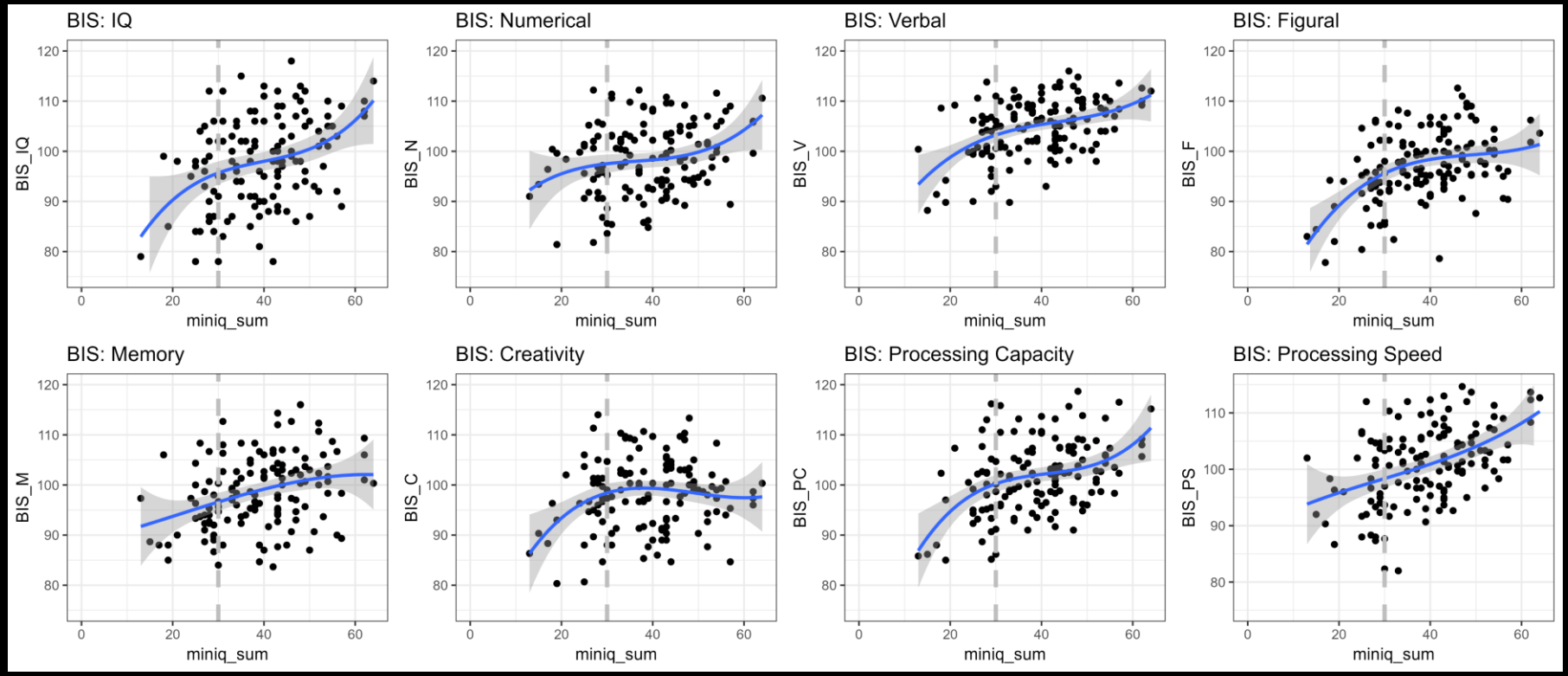

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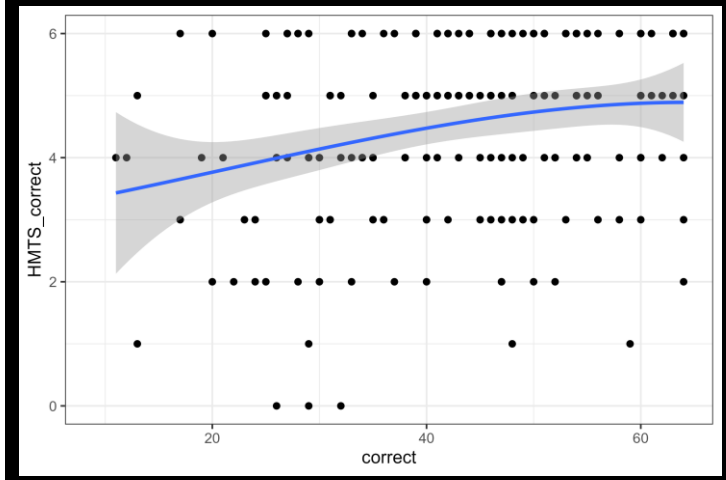

Relation with short-form of Hagen matrices test (six items)

Schubert et al. 2023

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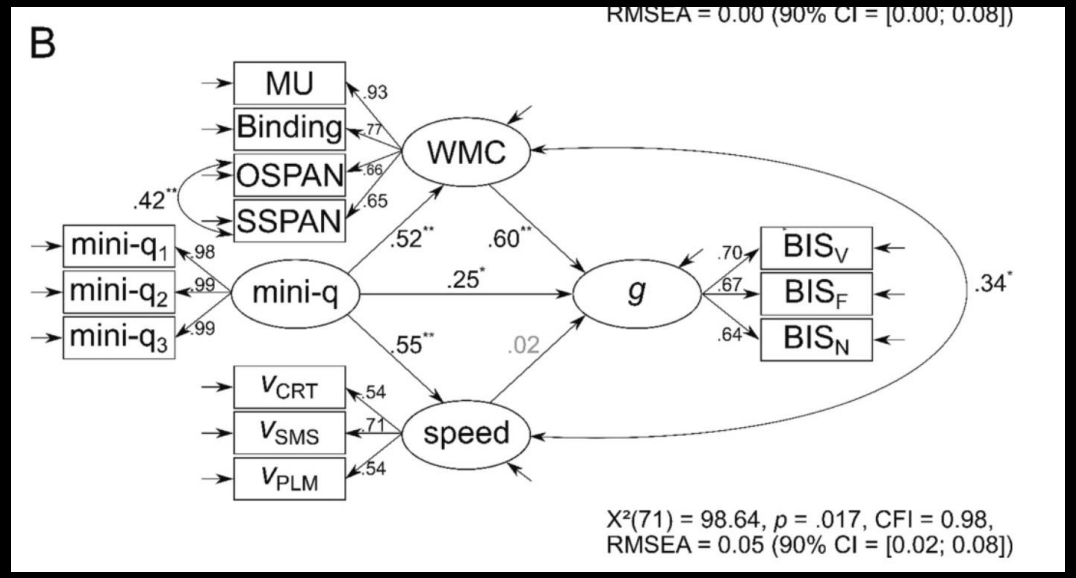

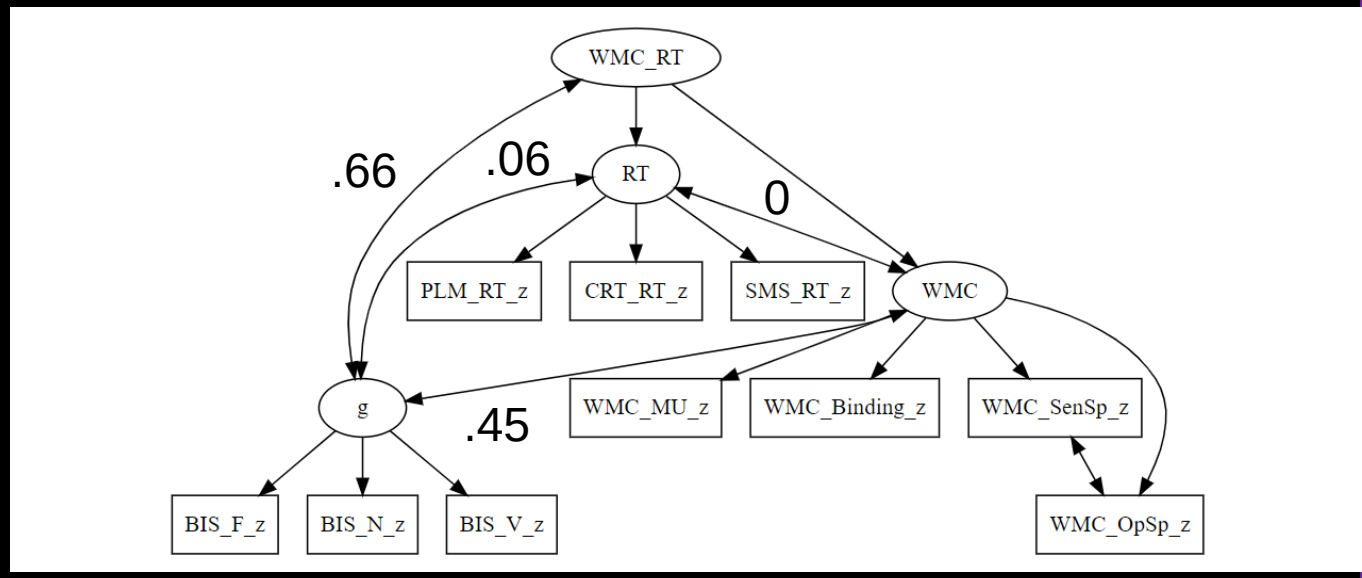

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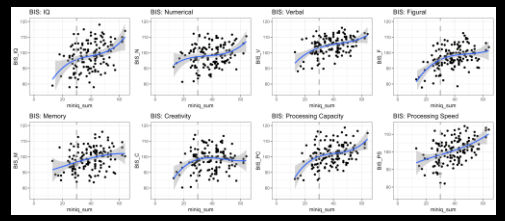

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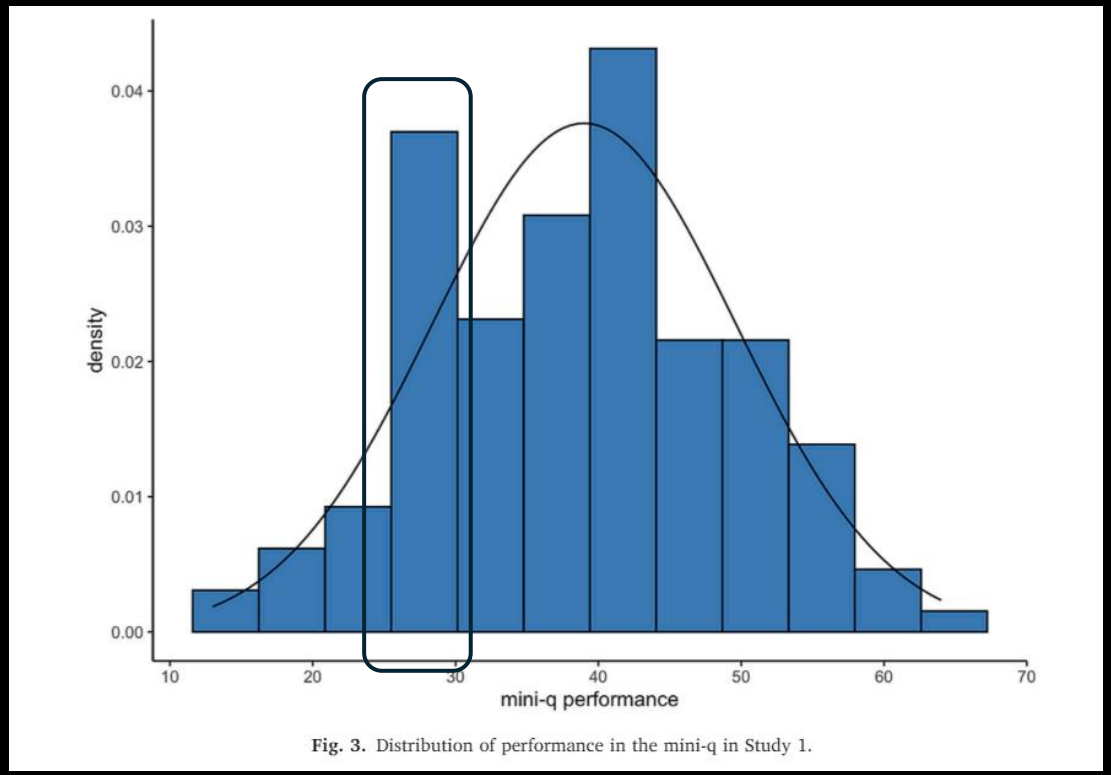

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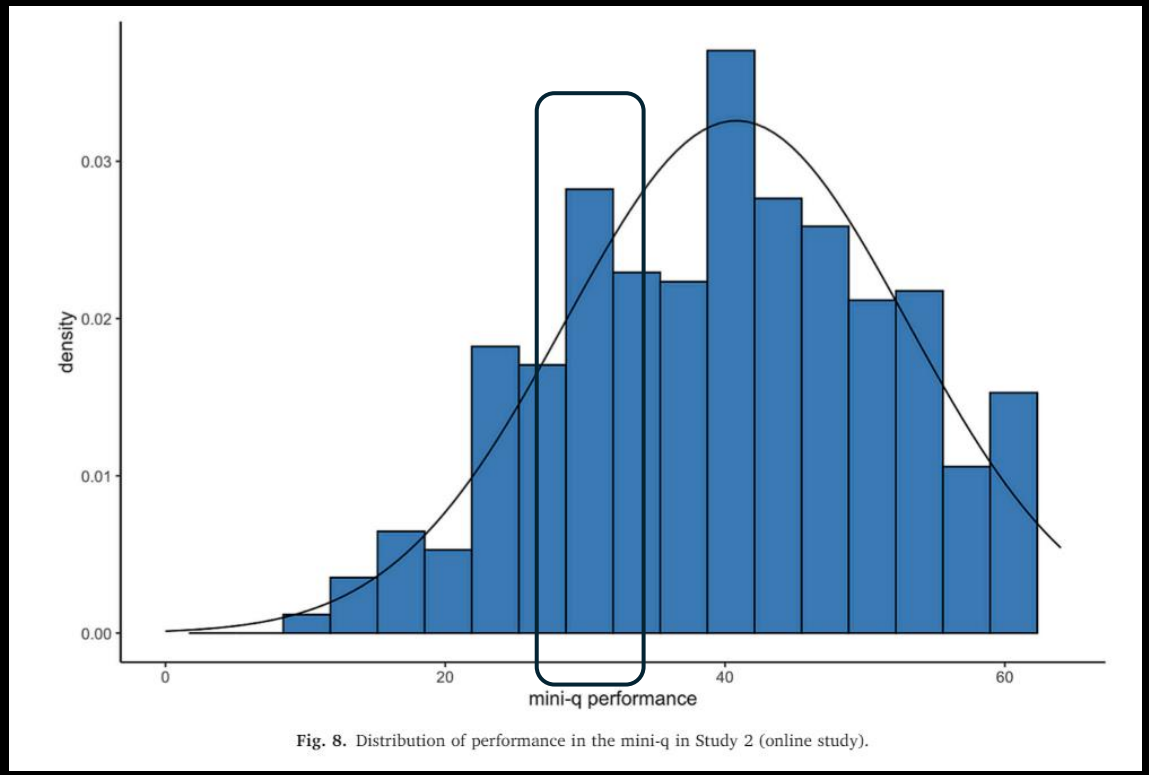

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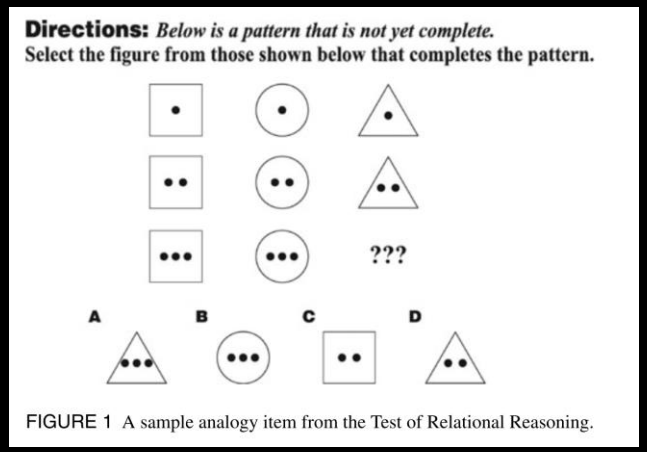

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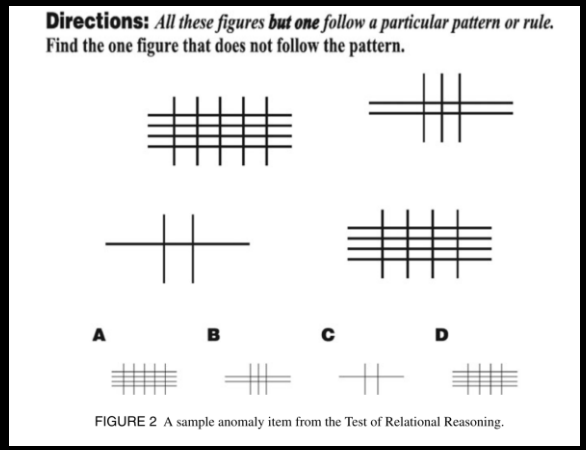

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