Le misure in psicologia sono significanti? Il caso del test della Torre di Londra

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Simposio: Crisi di replicabilità o crisi di validità? L'importanza delle misure

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The ratio between the measures of a and b is constant and independent of the measurement unit:

$$\frac{\varphi(a)}{\varphi(b)} = \frac{\varphi'(a)}{\varphi'(b)},$$

where φ and φ' are two different scales of measurement of the same variable.

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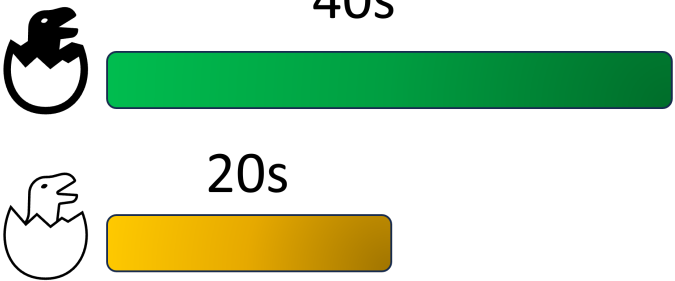
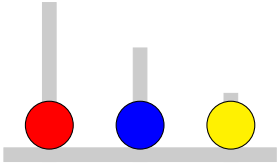
Meaningful comparisons

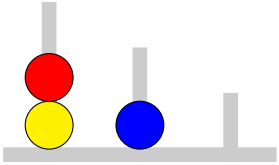
The comparison between a and b is meaningful if it is invariant under all the unit transformations.


40s
20s

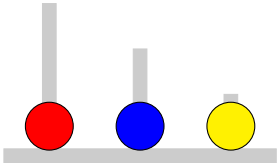

40s
20s



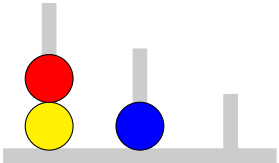
Starting configuration



Goal configuration



Starting configuration



Goal configuration

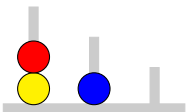
Item difficulty influenced by:

- Number of moves
- Number of alternative paths
- Hierarchy of the starting/goal configuration

The Tower of London Test (ToL Test)

Shallice (1982)

- 12 problems
- Same starting configuration
- More than one attempt per item



Problem	Minimum moves	Alternative paths
Example	2	1
1	2	1
2	2	1
3	3	2
4	3	1
5	4	2
6	4	1
7	4	1
8	4	1
9	5	2
10	5	1
11	5	1
12	5	2

Scoring	Attempts	Response times	Item score	Total score
Shallice 1	✓	✓	0-1	0-12
Shallice 2	×	✓	0-3	0-36
Anderson et al.	✓	✓	0-9	0-108
Kirkorian et al.	✓	×	0-3	0-36

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Shallice 2 – SH2

For each of the 12 items:

Assign	if time is
3	≤ 15 s
2	$15 \dashv 30$ s
1	$30 \dashv 60$ s
0	> 60 s

Anderson et al. – AN

For each of the 12 items:

Assign	if time is
9	≤ 6 s
8	$6 \dashv 10$ s
7	$11 \dashv 20$ s
6	$21 \dashv 40$ s
5	$41 \dashv 60$ s
0	> 60 s

Subtract the number of unsuccessful attempts

Both scorings are based on the discretization of the response times → There should not be differences in the **order** of the total score of the respondents according to the scoring method

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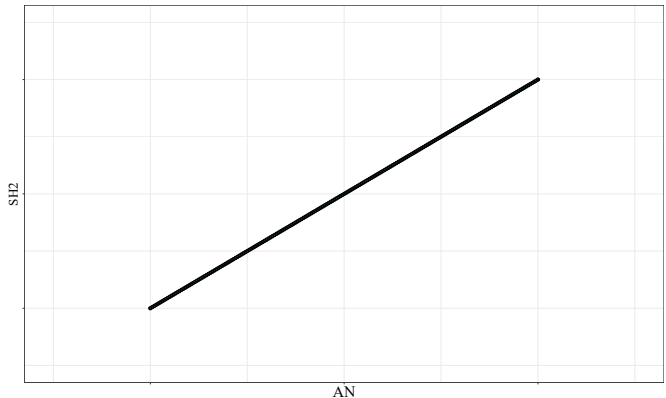
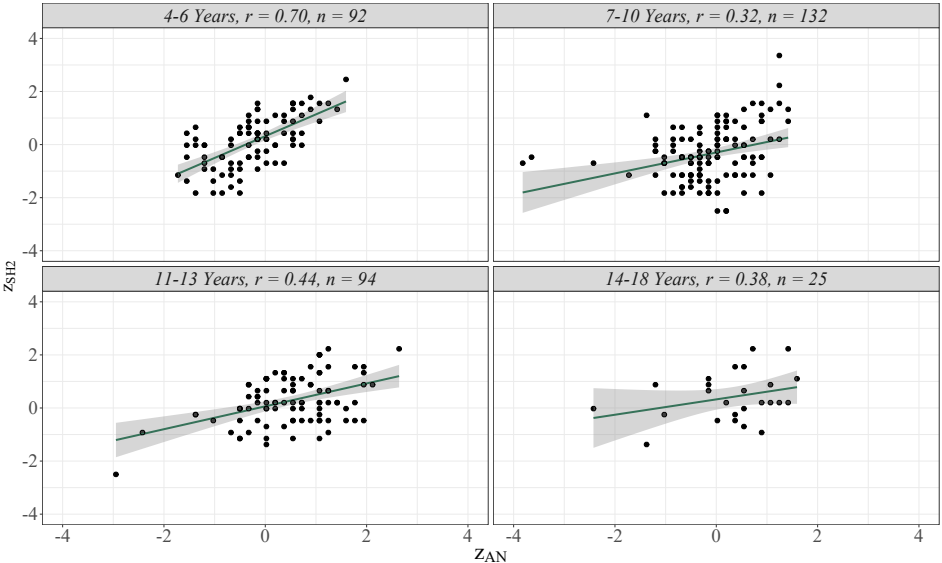



4-6 Years, r = 0.70, n = 92
7-10 Years, r = 0.32, n = 132
11-13 Years, r = 0.44, n = 94
14-18 Years, r = 0.38, n = 25
zSH2
zAN
4
2
0
-2
-4

Is it really bad...?

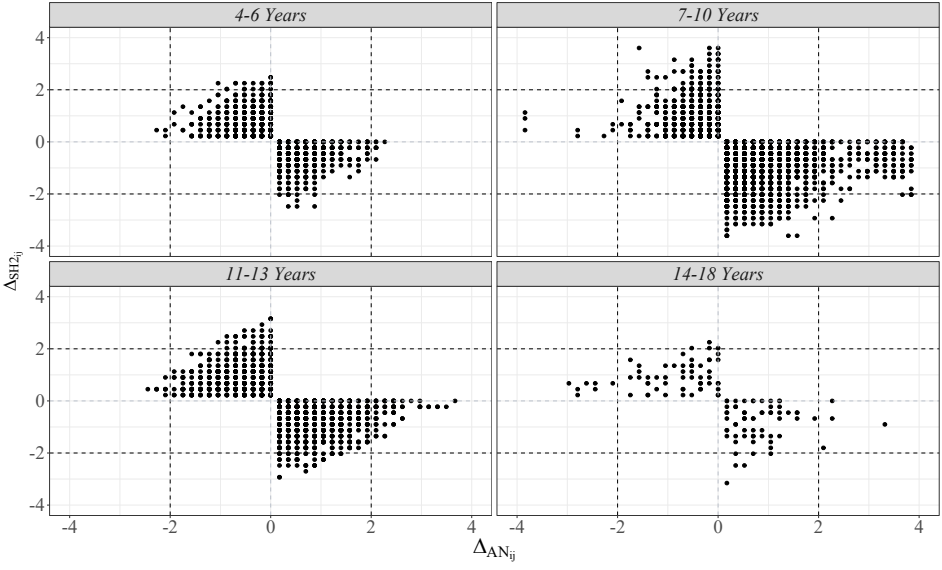
Respondents $i, j \in \{1, \dots N\}$

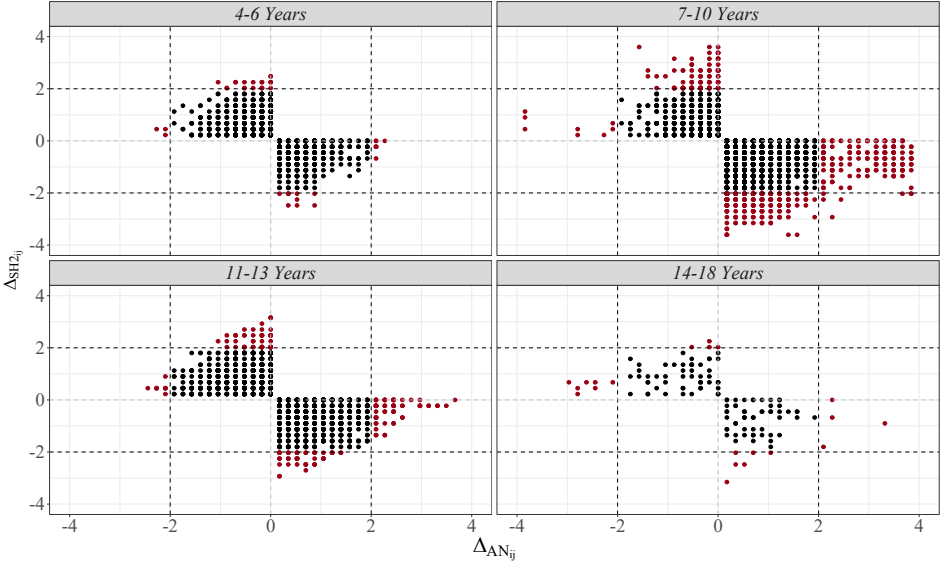
- AN Comparison (Δ_{AN}): The standardized AN score of each subject i is compared against the standardized AN score of every other subject j

$$\Delta_{\text{AN}_{ij}} = z_{\text{AN}_i} - z_{\text{AN}_j}$$

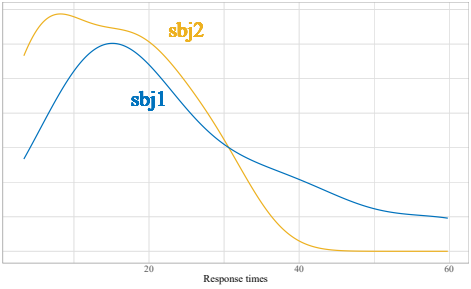
- SH2 Comparison (Δ_{SH2}): The standardized SH2 score of each subject i is compared against the standardized SH2 score of every other subject j

$$\Delta_{\text{SH2}_{ij}} = z_{\text{SH2}_i} - z_{\text{SH2}_j}$$


4-6 Years
7-10 Years
11-13 Years
14-18 Years
$\Delta_{SH2_{ij}}$
$\Delta_{AN_{ij}}$
4
2
0
-2
-4


4-6 Years
7-10 Years
11-13 Years
14-18 Years
$\Delta_{SH2_{ij}}$
$\Delta_{AN_{ij}}$
4
2
0
-2
-4

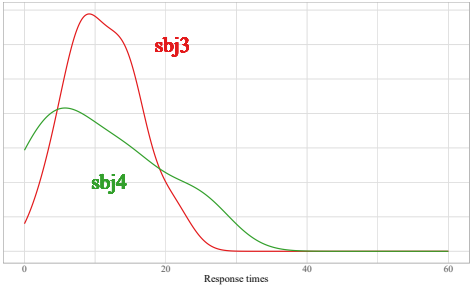
$\Delta_{\text{AN}} > 2$ & $\Delta_{\text{SH2}} \approx 0$



	z_{AN}	z_{SH2}	Accuracy	Time (sd)
sbj1	−1.55	0.43	0.75	24.10 (15.60)
sbj2	0.72	0.43	0.75	14.51 (9.22)

	Δ_{AN}	Δ_{SH2}
sbj1 − sbj2	2.27	0.00

$\Delta_{\text{AN}} \approx 0$ & $\Delta_{\text{SH2}} > 2$



	z_{AN}	z_{SH2}	Accuracy	Time (sd)
sbj3	−0.15	1.55	0.75	11.14 (4.96)
sbj4	0.20	−0.70	0.58	10.72 (8.60)

	Δ_{AN}	Δ_{SH2}
sbj3 − sbj4	−0.35	2.25

Highlights

- Different scoring systems → The focus is shifted: Fast and furious or slow and steady?
- Different scoring systems might favor a cognitive theory over a contrasting one (raising also replicability issues)

Research founded by the project "Computerized, Adaptive and Personalized Assessment of Executive Functions and Fluid Intelligence" (PRIN 2020, Prot. 20209WKCLL, P.I. Prof. Luca Stefanutti)

Thank you!

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