

Le misure in psicologia sono significanti?

Il caso del test della Torre di Londra

Ottavia M. Epifania, Luca Stefanutti, Pasquale Anselmi, Andrea
Brancaccio, Debora de Chiusole



Dipartimento di Filosofia, Sociologia, Pedagogia e Psicologia Applicata,
Università di Padova

Convegno AIP-Sezione Sperimentale 2023
Simposio: Crisi di replicabilità o crisi di validità? L'importanza delle
misure

19 Settembre 2023

① Meaningfulness

② The case in point

- Tower of London
- Scoring systems

③ Real data application

④ Final remarks

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.

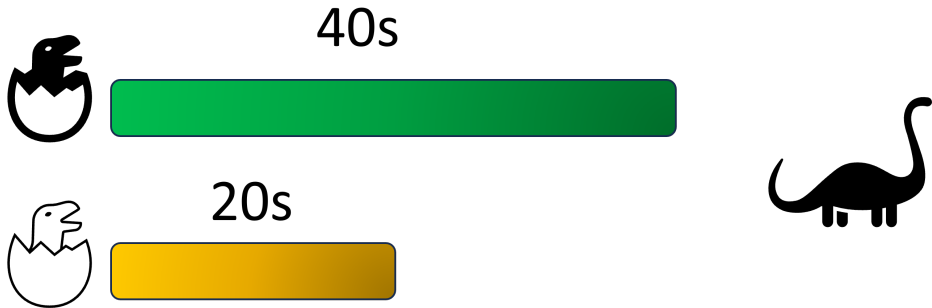
The ratio between the measures of a and b is constant and independent of the measurement unit:

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

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

Meaningful comparisons

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





40s

20s



① Meaningfulness

② The case in point

- Tower of London
- Scoring systems

③ Real data application

④ Final remarks

1 Meaningfulness

2 The case in point

- Tower of London
- Scoring systems

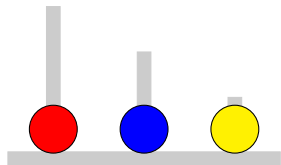
3 Real data application

4 Final remarks

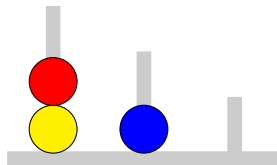
Meaningfulness

- └ The case in point

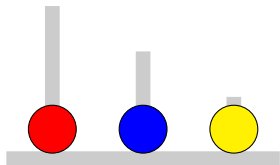
- └ Tower of London



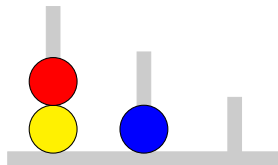
Starting configuration



Goal configuration



Starting configuration



Goal configuration

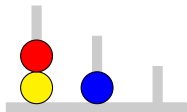
Item difficulty influenced by:

- 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

1 Meaningfulness

2 The case in point

- Tower of London
- Scoring systems

3 Real data application

4 Final remarks

Meaningfulness

└ The case in point

└ Scoring systems

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

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

Shallice 2 – SH2

Anderson et al. – AN

For each of the 12 items:

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

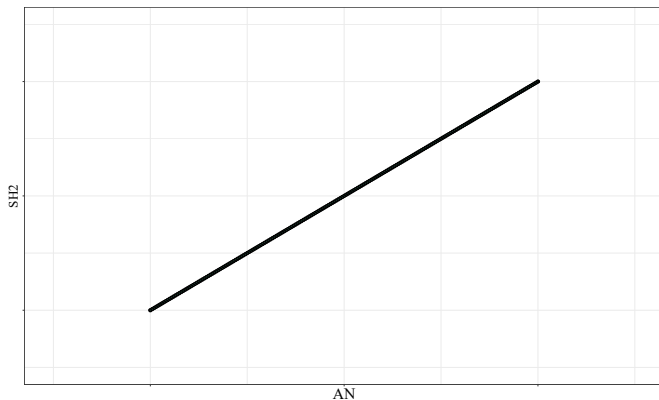
For each of the 12 items:

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

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



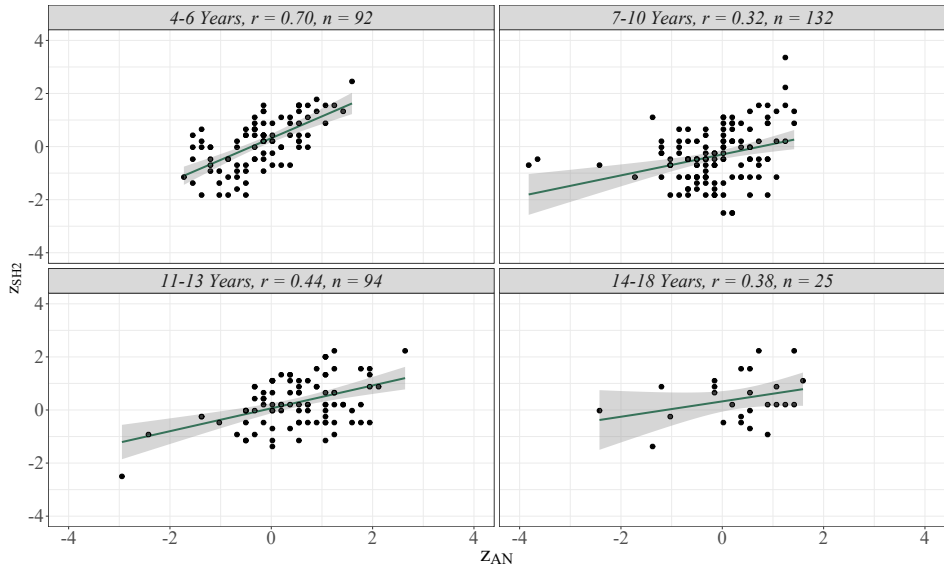
① Meaningfulness

② The case in point

- Tower of London
- Scoring systems

③ Real data application

④ Final remarks



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

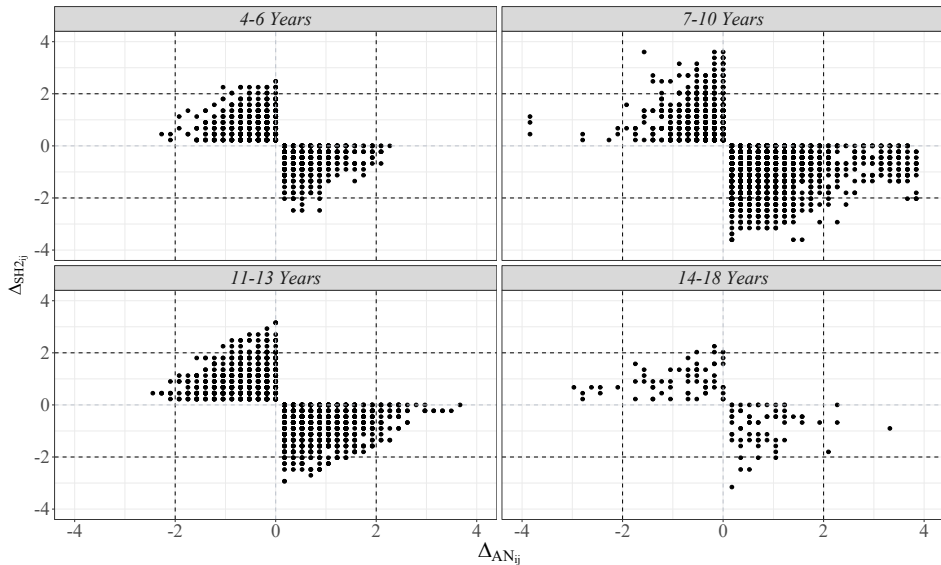
$$\Delta_{AN_{ij}} = z_{AN_i} - z_{AN_j}$$

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

$$\Delta_{SH2_{ij}} = z_{SH2_i} - z_{SH2_j}$$

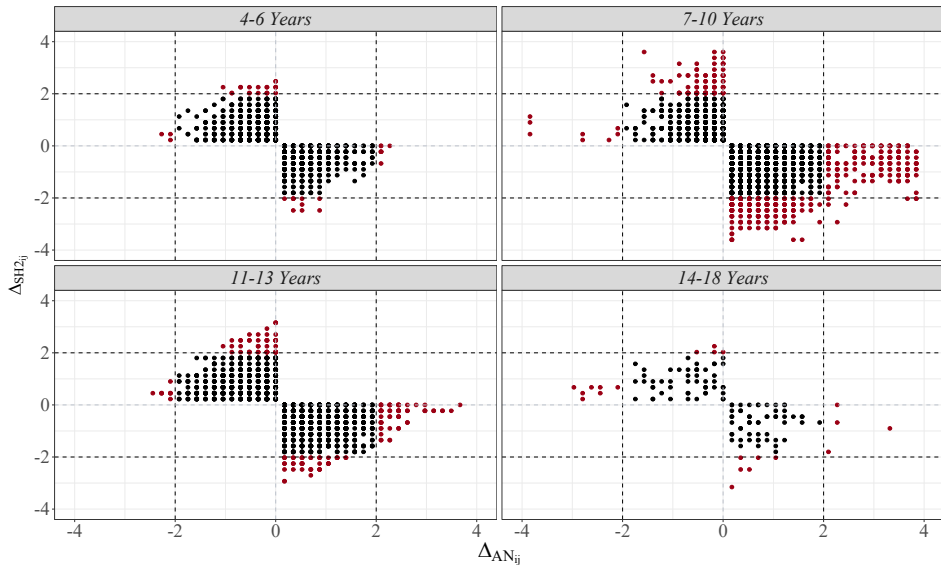
Meaningfulness

└ Real data application

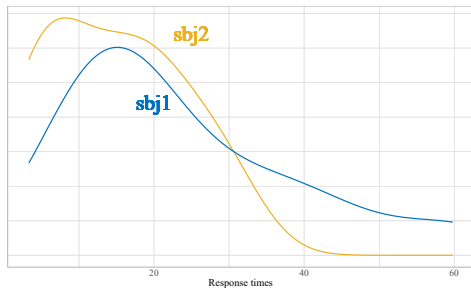


Meaningfulness

└ Real data application



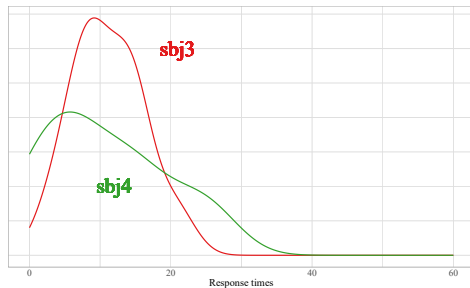
$$\Delta_{AN} > 2 \text{ \& } \Delta_{SH2} \approx 0$$



	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

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



	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

- ① Meaningfulness
- ② The case in point
 - Tower of London
 - Scoring systems
- ③ Real data application
- ④ **Final remarks**

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!

ottavia.epifania@unipd.it