Measurement Invariance in Cross-Cultural and Comparative Research: Controversies and New Procedures

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- General Approach
- Study 1: Attitude toward Immigration in the ESS
- Study 2: Revised Value Scale
- Study 3: Invariance of Universalism Value over time and countries in the ESS
- Outlook: Approximate Measurement Invariance, Alignment, Robustness checks, Multilevel CFA/SEM as explanatory tool.

Measurement invariance

- psychometric property of a questionnaire

The questionnaire is measurement invariant
when it measures

- **the same construct**
- **in the same way**
- **across different groups**, such as countries, cultures or other geographical regions, conditions of data collection or time points

Measurement invariance

is a precondition for any meaningful comparison of means, correlates and regression coefficients of the measured construct across groups(Proof given by Meredith 1993, elaborated in Millsap 2011, Guenole/Brown 2015)

Approaches to measurement invariance

1) Assuming it (→dangerous)

2) Empirical assessment

→ establishing full MI (rather seldom)

→ in case of lack of MI

- looking for partial MI (Byrne, Shavelson & Muthén 1989)

- dropping groups or items

- refraining from cross-group comparisons

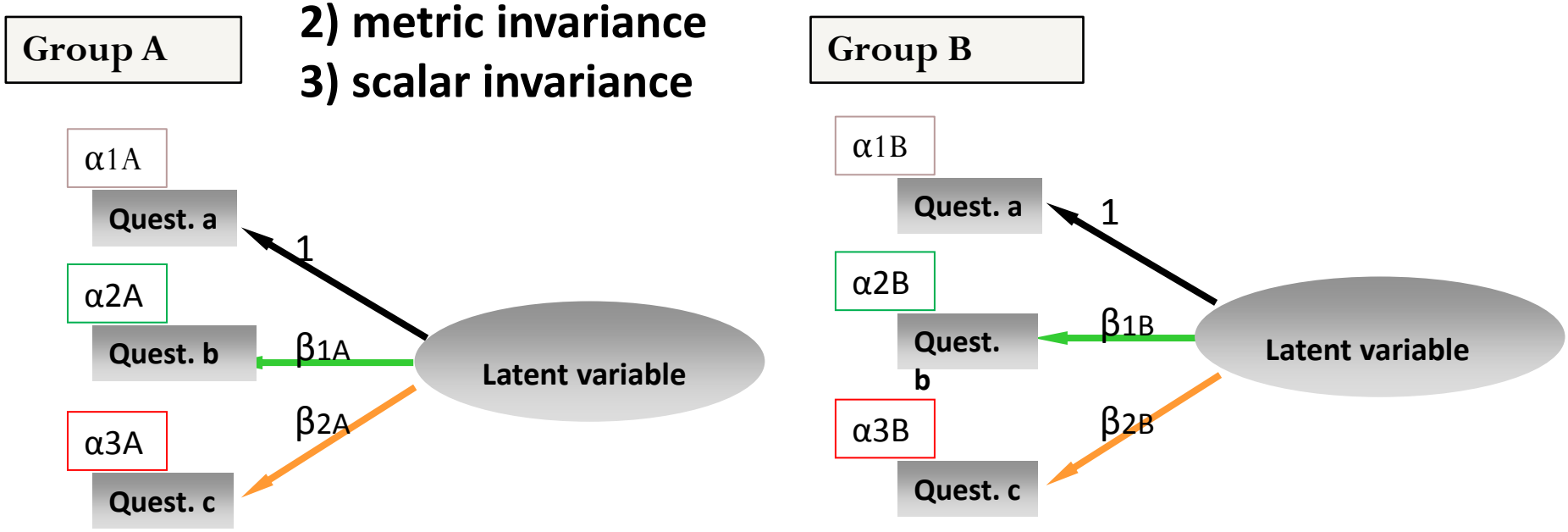
-looking for alternative appropriate methods to assess cross-group invariance

- checking for robustness(Oberski 2014, Kouha/Moustaki 2015)

Most often used approach to test for measurement invariance:

1) Multigroup Confirmatory Factor Analysis - MGCFA (Bollen 1989, Jöreskog 1971)

1) configural invariance
2) metric invariance
3) scalar invariance



2) Evaluation based on differences in global model fit indices between models (Chen, 2007)

Alternative approaches in the framework of MGCFA:

1) Test for approximate (Bayesian) rather than exact measurement invariance (Muthén & Asparouhov, 2013)

2) Evaluation of exact measurement invariance based on local misspecifications (Saris, Satorra & van der veld, 2009)

Note!

Similar assumption in both approaches:
allowing for some „small" deviation

Evaluation of exact measurement invariance based on local misspecifications

Saris et al.'s (2009) proposal:

1) to rely on modification indices,

that provide information on the minimal decrease in the χ^2 of a model when a given constraint is released, and –

2) to take into account the power of the modification index test.

The size of misspecification is defined by the researcher

Saris et al.'s (2009) suggestion:
As misspecified can be treated:
- deviations larger than .4 for cross-loadings
- deviations larger than .1 for differences in factor loadings or intercepts across groups

Study 1

The comparability of attitudes toward immigration in the European Social Survey:

Exact versus approximate measurement equivalence

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Jan Cieciuch – University of Zurich, University of Finance and Management in Warsaw

Peter Schmidt – University of Giessen

Bart Meuleman – University of Leuven

René Algesheimer – University of Zurich

Data and Measurements

- A total of 35 countries and 6 rounds of the ESS (2002/3, 2004/5, 2006/7, 2008/9, 2010/11, 2012/13) are included in the study.
- Not all countries participated in all rounds.
- Some joined early on in 2002/3 and did not participate in other later rounds.
- Other countries were not part of the ESS at the beginning but joined later.

Data and Measurements

- Table 1 summarizes the number of participants in each round, the percentage of female respondents, and the mean and standard deviations of the respondents' age in each country.
- Data in each country included both respondents with and without immigration background.
- We excluded respondents with a migration background from our analysis to avoid positivity bias in the scores.

Data and Measurements

- Thus, the total sample included 271,220 respondents.
- The data were retrieved from the ESS website, www.europeansocialsurvey.org.
- Further information on data collection procedures, the full questionnaire, response rates, and methodological documentation is available on the ESS website.

Data and Measurements

- Three items in the ESS measured attitudes toward immigration.
- They ask whether respondents prefer their country to allow more or fewer immigrants who belong to a certain group to come into the country.

Data and Measurements

- The first group consists of people of *the same race or ethnic group from most [country] people*,
- the second group consists of people of *a different race or ethnic group from most [country] people*,
- and the third consists of people from *poorer countries outside Europe*.
- Respondents record their responses to these three questions on 4-point scales ranging from 1 (*allow none*) to 4 (*allow many*).

Data and Measurements

Number of respondents (N) by country and ESS round with % of female (% F) and mean and standard deviation of age

	1st Round (2002/3)			2nd Round (2004/5)			3rd Round (2006/7)			4th Round (2008/9)			5th Round (2010/11)			6th Round (2012/13)		
	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})
1. Austria	2053	54.0	46.74 (17.19)	2074	53.7	43.65 (17.91)	2236	53.7	44.18 (17.91)	1987	54.4	47.13 (18.52)						
2. Belgium	1739	47.7	44.61 (18.48)	1619	51.2	45.17 (18.48)	1645	52.6	46.21 (18.86)	1586	51.6	46.43 (19.00)	1516	51.1	47.17 (19.16)	1606	50.9	47.71 (19.47)
3. Bulgaria							1387	60.9	49.83 (17.80)	2210	56.1	51.78 (17.64)	2412	56.4	53.30 (17.84)	2247	57.5	53.95 (16.95)
4. Croatia										1353	56.2	46.78 (18.25)	1474	56.3	50.58 (18.99)			
5. Cyprus							945	51.9	46.88 (17.54)	1119	49.3	45.38 (18.04)	1016	54.3	48.72 (18.91)	991	56.2	48.96 (18.59)
6. Czech Republic	1297	51.6	51.46 (17.55)	2890	53.2	48.08 (17.88)				1976	51.2	46.90 (17.37)	2339	50.1	46.79 (17.64)	1944	50.7	47.54 (17.11)
7. Denmark	1422	48.7	46.74 (17.73)	1415	51.1	47.23 (17.78)	1403	50.8	49.90 (17.61)	1510	49.6	49.54 (18.09)	1475	48.7	48.78 (18.62)	1536	48.6	48.94 (19.22)
8. Estonia				1615	57.9	44.66 (19.48)	1199	55.8	44.55 (19.22)	1305	56.6	44.94 (18.98)	1517	58.0	46.45 (19.43)	1991	56.8	47.01 (19.41)
9. Finland	1937	51.7	45.95 (18.53)	1983	52.8	47.53 (18.67)	1838	51.0	48.73 (19.05)	2139	50.9	48.26 (18.76)	1813	51.5	49.20 (19.27)	2103	51.2	50.24 (18.92)
10. France	1353	54.8	47.16 (18.56)	1670	53.8	48.70 (18.04)	1791	53.2	48.15 (17.84)	1911	54.3	48.59 (18.96)	1573	53.2	49.24 (18.56)			

Data and Measurements

Number of respondents (N) by country and ESS round with % of female (% F) and mean and standard deviation of age

	1st Round (2002/3)			2nd Round (2004/5)			3rd Round (2006/7)			4th Round (2008/9)			5th Round (2010/11)			6th Round (2012/13)		
	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})
11. Germany	2705	51.7	47.64 (17.95)	2625	51.4	47.27 (17.97)	2687	50.7	48.18 (18.12)	2518	47.5	49.40 (17.43)	2743	48.0	48.09 (18.53)	2658	49.3	49.17 (18.74)
12. Greece	2302	57.2	50.59 (19.22)	2164	56.4	51.30 (18.85)				1950	54.8	45.59 (16.87)	2447	55.9	48.45 (19.05)			
13. Hungary	1645	51.9	45.91 (18.20)	1465	56.8	46.58 (18.09)	1484	58.8	51.13 (18.54)	1514	54.2	47.70 (19.10)	1518	53.8	47.70 (18.35)	1989	55.0	47.14 (18.20)
14. Iceland				554	51.8	44.54 (17.71)										707	49.8	44.64 (18.84)
15. Ireland	1890	53.5	45.98 (17.84)	2138	43.3	48.24 (18.08)	1561	52.8	47.16 (18.35)	1479	54.5	49.39 (18.29)	2170	54.5	47.82 (19.12)	2244	53.0	48.65 (18.17)
16. Israel	1626	50.4	36.13 (15.79)							1588	51.9	38.97 (16.07)	1529	51.7	39.48 (16.87)	1725	52.9	39.11 (16.50)
17. Italy	1181	54.4	47.01 (17.89)	1494	50.7	48.01 (18.09)												
18. Kosovo																1222	51.2	43.33 (17.04)
19. Latvia							1753	59.1	40.76 (19.06)	1706	61.6	46.52 (18.56)						
20. Lithuania										1916	49.8	44.59 (18.86)	1592	64.1	51.54 (19.46)			

Data and Measurements

Number of respondents (N) by country and ESS round with % of female (% F) and mean and standard deviation of age

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21. Luxembourg	1069	51.7	43.76 (19.65)	1147	48.0	44.07 (18.78)												
22. Netherlands	2207	56.0	48.20 (17.13)	1717	58.8	49.88 (17.49)	1711	53.8	49.30 (17.87)	1610	54.3	49.77 (18.00)	1688	54.3	50.71 (17.66)	1677	53.1	51.48 (18.16)
23. Norway	1903	46.1	46.12 (17.22)	1632	47.8	46.06 (17.43)	1625	48.5	45.94 (18.32)	1418	47.5	46.15 (18.14)	1373	47.9	47.14 (18.76)	1421	47.4	46.87 (18.38)
24. Poland	2079	51.1	42.57 (18.51)	1697	51.5	41.93 (17.92)	1696	52.8	43.53 (18.45)	1596	52.7	44.36 (18.86)	1723	51.9	44.04 (18.74)	1872	52.1	45.83 (18.69)
25. Portugal	1421	58.5	48.52 (19.11)	1932	60.6	50.09 (19.48)	2078	61.6	52.22 (19.02)	2229	60.7	53.48 (19.87)	2004	60.1	54.81 (19.19)	2019	60.1	52.87 (19.08)
26. Romania							2130	52.4	46.12 (18.45)	2088	54.8	46.03 (17.64)						
27. Russia							2280	59.6	46.19 (19.11)	2376	60.9	47.22 (19.06)	2435	59.4	46.29 (18.61)	2334	61.6	45.90 (18.12)
28. Slovakia				1465	48.4	42.15 (17.83)	1703	50.7	42.97 (17.79)	1760	61.6	49.95 (17.16)	1802	61.3	50.40 (17.39)	1815	59.2	49.26 (16.56)
29. Slovenia	1374	52.4	44.04 (18.58)	1320	52.9	44.89 (19.21)	1362	54.8	46.09 (19.06)	1178	53.4	46.05 (19.08)	1280	53.5	46.92 (18.73)	1144	54.5	47.76 (19.06)

Data and Measurements

Number of respondents (N) by country and ESS round with % of female (% F) and mean and standard deviation of age

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	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})	N	% F	M_{age} (SD_{age})
30. Spain	1648	52.5	49.01 (19.32)	1545	49.0	45.72 (18.94)	1730	52.3	46.48 (19.09)	2341	52.8	47.87 (19.38)	1693	51.3	46.65 (18.57)	1671	51.5	48.34 (18.29)
31. Sweden	1785	49.0	46.44 (18.75)	1762	49.4	47.04 (19.00)	1710	50.1	47.21 (18.92)	1616	49.8	47.59 (19.33)	1324	50.8	48.77 (19.54)	1613	48.2	48.16 (19.26)
32. Switzerland	1696	51.0	47.58 (17.67)	1748	54.9	48.61 (18.50)	1464	53.9	50.15 (18.32)	1392	55.8	49.42 (18.89)	1155	49.0	48.00 (19.38)	1157	48.7	47.73 (19.32)
33. Turkey				1830	55.4	39.01 (16.74)				2389	53.4	39.47 (16.39)						
34. Ukraine				1763	63.2	48.81 (18.74)	1759	61.2	47.75 (18.81)	1654	62.2	47.81 (18.68)	1717	62.7	49.32 (18.94)			
35. UK	1860	53.2	48.94 (18.60)	1724	54.9	48.37 (18.92)	2158	55.1	49.93 (19.18)	2106	54.6	49.68 (18.56)	2151	56.6	50.76 (18.91)	2020	57.8	52.48 (19.24)
Total	38,192			44,988			43,335			55,520			47,479			41,706		

Plan of Analysis

1. Testing for exact (full or partial) scalar equivalence

- First, we ran 6 MGCFA analyses using the full information maximum likelihood (FIML) procedure (Schafer and Graham 2002), one for each round, with all the countries included in this round.
- Each analysis contained three assessments for configural, metric, and scalar equivalence, respectively, with the corresponding constraints for the metric and scalar levels of measurement equivalence.
- To identify the model we used the approach proposed by Little, Slegers, and Card (2006) and constrained the loading of one of the items to 1 and the intercept of this item to 0 in all countries.

Plan of Analysis

1. Testing for exact (full or partial) scalar equivalence

- If it turned out that the loading and/or intercept of this item varied considerably across countries, we used a different reference item for identification.
- When full measurement equivalence was not established, we tried to assess partial measurement equivalence.
- We used the program Jrule (Saris, Satorra and van der Veld 2009; Oberski 2009) for the detection of local misspecifications of parameters whose equality constraint should be released according to the program.

Plan of Analysis

1. Testing for exact (full or partial) scalar equivalence

- In order to establish partial scalar equivalence, only one item could be released, because partial scalar equivalence requires that parameters of at least two items are constrained to be equal across all groups.
- However, as will be shown in the next section, results of analyses using Jrule indicated misspecifications for two or even three items in several countries.
- This indicated that in these countries even partial scalar equivalence could not be established.

Plan of Analysis

2. Testing for approximate scalar equivalence

- Assessing approximate measurement equivalence using Bayesian analysis requires imposing priors on specific parameters.
- When testing for approximate measurement equivalence, the *average* difference between loadings and intercepts across countries is assumed to be zero as in MGCFA when one tests for exact measurement equivalence with one exception:
- Approximate measurement equivalence permits 'small' differences between parameters otherwise constrained to be exactly equal in the classical approach for testing for measurement equivalence.

Plan of Analysis

2. Testing for approximate scalar equivalence

- van de Schoot et al. (2013) demonstrated, using simulation studies, that variance as large as 0.05 imposed on the difference between the loadings or the intercepts does not lead to biased conclusions when approximate equivalence is assessed.
- We followed their recommendations and imposed the following priors on the difference parameters of the loadings and intercepts:

  mean difference = 0, variance of the difference = .05.

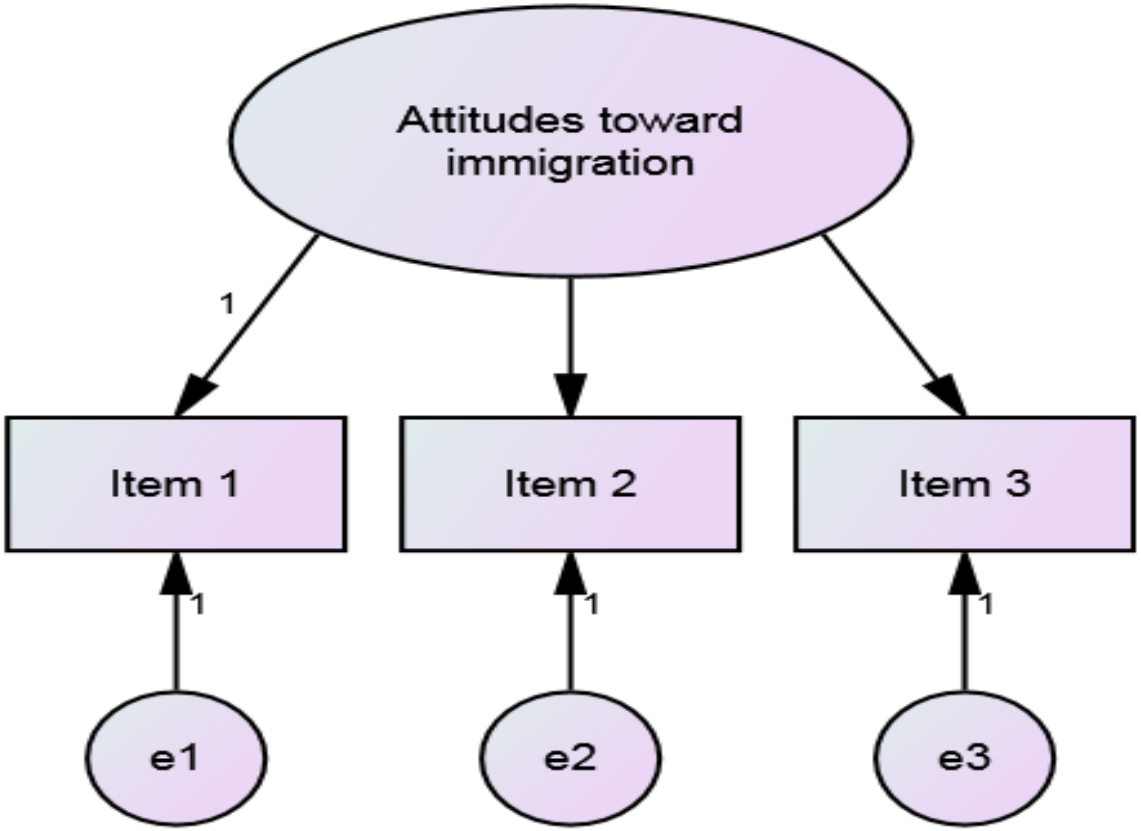
Plan of Analysis

2. Testing for approximate scalar equivalence

- We used similar constraints to identify the model as in the MGCFA:
  - We constrained the loading of one item to (exactly) 1 in all groups and the intercept of this item to (exactly) 0 in all groups.
- If the loading and/or intercept of this item varied considerably across countries, we chose a different reference item to use for identification.
- The latent mean was freely estimated in all countries.

Results

- A measurement model with a latent variable measuring attitudes toward immigration with three items (Item 1 – Item 3) and three measurement errors (e1-e3).



Results

Global fit measures for the exact measurement equivalence test in each ESS round

	Chi2	df	RMSEA	SRMR	CFI
1st Round of ESS					
Configural	0.0	0	.000	.000	1.00
Metric	523.5	42	.083 [.076-.089]	.057	.993
Partial metric	200.5	21	.071 [.062-.080]	.029	.997
Partial scalar	465.7	42	.077 [.071-.084]	.037	.994
2nd Round of ESS					
Configural	0.0	0	.000	.000	1.00
Metric	890.3	50	.100 [.094-.106]	.075	.989
Partial metric	167.1	25	.058 [.050-.067]	.026	.998
Partial scalar	860.6	50	.098 [.092-.104]	.045	.989
3rd Round of ESS					
Configural	0.0	0	.000	.000	1.00
Metric	969.8	48	.107 [.101-.113]	.071	.987
Partial metric	282.1	24	.080 [.072-.082]	.032	.996
Partial scalar	1209.1	48	.120 [.114-.126]	.055	.984

Results

Global fit measures for the exact measurement equivalence test in each ESS round

	Chi2	df	RMSEA	SRMR	CFI
4rd Round of ESS					
Configural	0.0	0	.000	.000	1.00
Metric	1501.2	60	.118 [.113-.123]	.083	.985
Partial metric	289.9	30	.071 [.063-.078]	.030	.997
Partial scalar	1283.0	60	.108 [.103-.114]	.050	.987
5th Round of ESS					
Configural	0.0	0	.000	.000	1.00
Metric	1108.9	52	.109 [.103-.115]	.074	.987
Partial metric	150.6	26	.053 [.045-061]	.022	.998
Partial scalar	1289.3	52	.118 [.112-.123]	.048	.985
6th Round of ESS					
Configural	0.0	0	.000	.000	1.00
Metric	964.6	46	.109 [.103-.115]	.076	.987
Partial metric	201.0	23	.068 [.059-.076]	.032	.998
Partial scalar	1353.1	46	.130 [.124-.136]	.059	.982

Results

Countries with misspecified two or three intercepts according to Jrule (criterion >.01) with the percentage of countries that did not reach partial scalar equivalence on the second row

ESS1	ESS2	ESS3	ESS4	ESS5	ESS6
9% countries	15% countries	40% countries	32% countries	37% countries	42% countries
Hungary	Estonia	Bulgaria	Bulgaria	Denmark	Cyprus
Israel	Portugal	Cyprus	Denmark	Estonia	Estonia
	Slovenia	Denmark	Estonia	Germany	Germany
	Ukraine	Estonia	Germany	Hungary	Hungary
		Hungary	Hungary	Israel	Iceland
		Latvia	Israel	Lithuania	Israel
		Russia	Latvia	Netherlands	Kosovo
		Spain	Lithuania	Spain	Netherlands
		Switzerland	Norway	Switzerland	Portugal
		Ukraine	Ukraine	Ukraine	Switzerland

Results

Fit measures for the approximate measurement equivalence model in each ESS round

	ppp	95% Confidence Interval
1st Round of ESS	.057	(-13.517) - (+108.288)
2nd Round of ESS	.422	(-53.57) - (+67.905)
3rd Round of ESS	.364	(-47.766) - (+68.527)
4rd Round of ESS	.220	(-44.291) - (+94.843)
5th Round of ESS	.340	(-52.088) - (+71.308)
6th Round of ESS	.320	(-45.631) - (+75.837)

95% Confidence Interval = 95% Confidence Interval for the difference between the observed and the replicated chi-square values

ppp = the posterior predictive p-value

Results

Correlations of country rankings based on three methods (exact equivalence, approximate equivalence and raw scores) in six ESS rounds (ESS1/ESS2/ESS3/ESS4/ESS5/ESS6)

	Exact (partial scalar model)	**Approximate scalar model**
Approximate scalar model	.995 / .998 / .993 / .988 / .992 / .973	
Raw scores	.954 / .971 / .970 / .956 / .971 / .963	.966 / .972 / .975 / .955 / .966 / .980

Schwartz's theory of basic human values

Basic values -

Beliefs about the importance of abstract goals as guiding principles in life

1) Structure: circumplex continuum

2) Content: 10 value types

Previous findings of values measurement invariance

PVQ-21 (in the ESS) to measure 10 values with the „old" value model

- a disappointing result (Davidov, Schmidt, & Schwartz, 2008)

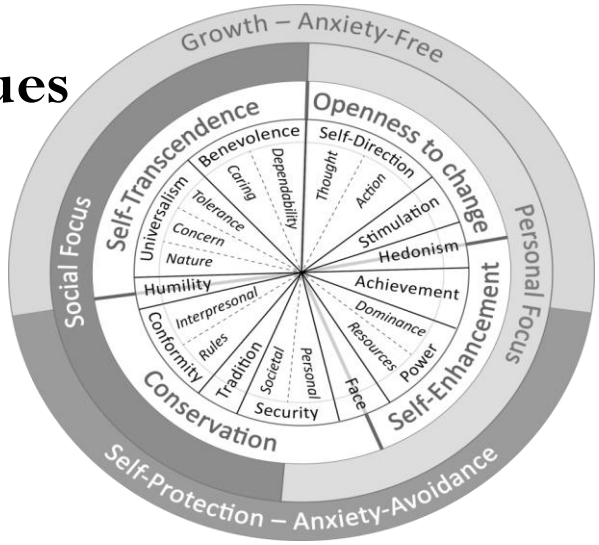
Most of the published analyses
were conducted on the ESS data (PVQ-21) by Davidov and colleagues
(e.g., Davidov, 2008; Davidov, 2010; Davidov, Schmidt, & Schwartz, 2008)

Lack of scalar measurement invariance

PVQ-57 to measure 19 values based on the „new" value model

- an encouraging result (Cieciuch et al., 2014)

Schwartz's refined theory of basic human values



1) Values are more narrowly defined (19).

2) There is greater homogeneity of items.

3) Each value is measured by three (rather than two) items.

Schwartz's refined theory of basic human values

The „old" value circle

10 values

PVQ-40

The „new" value circle

19 values

PVQ-57

➔ **PVQ-57 to measure 19 values**

➔ **Sample – eight countries:**

Finland, Israel, Italy, New Zealand, Poland, Portugal, Switzerland, USA

Country	N
Finland	334
Germany	325
Israel	394
Italy	382
New Zealand	141
Poland	545
Portugal	295
Switzerland	201

➔ **New PVQ5x developped to measure 19 values**

Encouraging results of exact MGCFA

Full metric invariance: 16 of the 19 values

and 3 values - full or partial metric invariance across alomst all countries

Full or partial scalar invariance: 10 of 19 values

across almost all countries (with a few exceptions for single countries):

- benevolence caring,
- universalism tolerance,
- universalism concern,
- universalism nature,
- hedonism,
- power dominance,
- power resources,
- security personal,
- security societal,
- self-direction thought

Cieciuch, Davidov, Vecchione, Beierlein, Schwartz, 2014

Results of the exact MGCFA

- **Metric:** ok!
- **Scalar:**

better than with the earlier PVQ version
BUT
there is still room for improvement
10 values invariant
and 9 values noninvariant

Is the test too strict??

Let's focus on the scalar measurement invariance and look into methods

= that allow for „small" deviations

Cieciuch, Davidov, Vecchione, Beierlein, Schwartz, 2014

Defined by the researcher

the size of misspecification

in the Saris et al. approach

≈

Defined by the researcher

the variance of parameters

in the Bayesian approach

misspecification of intercepts > .1

variance of intercepts = .01
variance of intercepts = .05

Jrule reads output from Mplus

Mplus

For each value separately, because of two reasons

1) **PPP with higher-order values and multiple values was always significant**
2) **We were interested only in scalar invariance test, because metric and configural invariance were already established**

We present one example in detail (SDT = self-direction thought) and a summary for all other values

Self-direction thought

Jrule
Misspecification at .1

Jrule for Mplus beta

File Edit Tools Help

Output file to read:

(None)

Parameters and misspecifications | Misspecification plots | Change decision rule

Filter by parameter

Parameter	Decision	Group	MI	EPC	Power	NCP
SDT BY SDT1	Misspecified	CH	10.608	-0.530	0.094	0.378
SDT BY SDT2	Misspecified	IT	46.335	-0.530	0.250	1.650
SDT BY SDT3	Misspecified	IT	36.749	0.395	0.336	2.355
SDT BY SDT3	Misspecified	PT	32.118	-0.528	0.169	1.152
SDT1	Misspecified	FI	30.943	0.240	0.640	5.372
SDT1	Misspecified	CH	13.854	-0.354	0.183	1.106
SDT1	Misspecified	IL	11.071	0.187	0.428	3.166
SDT1	Misspecified	PL	30.097	-0.290	0.473	3.579
SDT3	Misspecified	FI	39.077	-0.235	0.758	7.076
SDT3	Misspecified	IT	64.441	0.362	0.602	4.918
SDT3	Misspecified	PT	27.558	-0.345	0.331	2.315
SDT2	Misspecified	IT	60.291	-0.444	0.416	3.058

Mplus
Priors: variance of intercepts = .01

ppp = .495; CI = (-30.618) – (+32.148)

DIFFERENCE OUTPUT

	Average	Std. Dev.	Deviations from the Mean				
			NU1_1	NU2_1	NU3_1	NU4_1	NU5_1
3	4.263	0.069	0.154*	0.079	0.006	-0.058	-0.130*
			NU6_1	NU7_1	NU8_1		
			0.064	-0.108*	0.009		
			NU1_2	NU2_2	NU3_2	NU4_2	NU5_2
4	4.949	0.072	-0.019	0.069	-0.144*	0.045	0.063
			NU6_2	NU7_2	NU8_2		
			0.024	0.058	0.042		
			NU1_3	NU2_3	NU3_3	NU4_3	NU5_3
5	4.974	0.056	-0.138*	0.003	0.188*	0.011	0.091*
			NU6_3	NU7_3	NU8_3		
			-0.129*	0.048	-0.074		

Conclusions:

1) The results are very similar

2) Only two exceptions:

- **SDT1 in Israel: misspecified in Jrule, but not in Bayes**
- **SDT3 in Poland: misspecified in Bayes but not in Jrule**

Self-direction thought

Jrule
Misspecification at .1

Jrule for Mplus beta

File Edit Tools Help

Output file to read:

(None)

Parameters and misspecifications | Misspecification plots | Change decision rule

Filter by parameter

Parameter	Decision	Group	MI	EPC	Power	NCP
SDT BY SDT1	Misspecified	CH	10.608	-0.530	0.094	0.378
SDT BY SDT2	Misspecified	IT	46.335	-0.530	0.250	1.650
SDT BY SDT3	Misspecified	IT	36.749	0.395	0.336	2.355
SDT BY SDT3	Misspecified	PT	32.118	-0.528	0.189	1.152
SDT1	Misspecified	FI	30.943	0.240	0.640	5.372
SDT1	Misspecified	CH	13.854	-0.354	0.183	1.106
SDT1	Misspecified	IL	11.071	0.187	0.428	3.166
SDT1	Misspecified	PL	30.097	-0.290	0.473	3.579
SDT3	Misspecified	FI	39.077	-0.235	0.758	7.076
SDT3	Misspecified	IT	64.441	0.362	0.602	4.918
SDT3	Misspecified	PT	27.558	-0.345	0.331	2.315
SDT2	Misspecified	IT	60.291	-0.444	0.416	3.058

Mplus

Priors: variance of intercepts = .05

ppp = .502; CI = (-33.555) – (+31.803)

DIFFERENCE OUTPUT

	Average	Std. Dev.	Deviations from the Mean				
			NU1_1	NU2_1	NU3_1	NU4_1	NU5_1
3	4.251	0.111	0.226*	0.107	0.009	-0.071	-0.179
			NU6_1	NU7_1	NU8_1		
			0.109	-0.192	-0.010		
			NU1_2	NU2_2	NU3_2	NU4_2	NU5_2
4	4.944	0.116	-0.038	-0.093	-0.186	0.054	0.067
			NU6_2	NU7_2	NU8_2		
			0.046	0.102	0.050		
			NU1_3	NU2_3	NU3_3	NU4_3	NU5_3
5	4.960	0.086	-0.198*	0.003	0.234*	0.024	0.110
			NU6_3	NU7_3	NU8_3		
			-0.185*	0.098	-0.091		

Conclusions:

8 parameters misspecified in Jrule, while in Bayes 4 parameters are misspecified

Conclusion

Detection for local misspecification

Test for approximate measurement invariance

Diagnosis of „ill" items is quite similar

BUT

the treatment (therapy) is different

In order to reach an acceptable model, there is a need to release the misspecified parameters

It can lead to
- lack of measurement invariance
- or to dropping groups

There is no need to release the misspecified items, **if the ppp indicates an acceptable model fit**

Summary

Openness

Exact MI
** = full scalar MI
* = partial scalar MI
- = lack of scalar MI

Approximate MI
ok = scalar MI

	SDT	SDA	ST	HE
Finland	*	-	-	**
Germany	*	-	-	**
Israel	*	-	-	**
Italy	*	-	-	**
New Zealand	*	-	-	**
Poland	*	-	-	-
Portugal	*	-	-	**
Switzerland	*	-	-	-

Summary

Openness

Exact MI
** = full scalar MI
* = partial scalar MI
- = lack of scalar MI

Approximate MI
ok = scalar MI

	SDT	SDA	ST	HE
Finland	ok	ok	ok	ok
Germany	ok	ok	ok	ok
Israel	ok	ok	ok	ok
Italy	ok	ok	ok	ok
New Zealand	ok	ok	ok	ok
Poland	ok	ok	ok	ok
Portugal	ok	ok	ok	ok
Switzerland	ok	ok	ok	ok

Summary

Self-enhancement

Exact MI
**** = full scalar MI**
*** = partial scalar MI**
- = lack of scalar MI

Approximate MI
ok = scalar MI

	AC	POD	POR
Finland	-	**	**
Germany	-	**	**
Israel	-	*	**
Italy	-	**	**
New Zealand	-	**	**
Poland	-	**	-
Portugal	-	-	**
Switzerland	-	**	**

Summary

Self-enhancement

Results of Bayesian analysis

	Variance = .05	
Value (number of items)	95% CI	ppp
Achievement (3)	-24.31; 43.4	.275
Power Resources (2)	-25.38; 25.10	.478
Power Dominance (2)	-24.72; 27.14	.466

Summary

Self-enhancement

Exact MI
** = full scalar MI
* = partial scalar MI
- = lack of scalar MI

Approximate MI

ok = scalar MI

	AC	POD	POR
Finland	ok	ok	ok
Germany	ok	ok	ok
Israel	ok	ok	ok
Italy	ok	ok	ok
New Zealand	ok	ok	ok
Poland	ok	ok	ok
Portugal	ok	ok	ok
Switzerland	ok	ok	ok

Summary

Conservation

Exact MI
** = full scalar MI
* = partial scalar MI
- = lack of scalar MI

Approximate MI

ok = scalar MI

	FAC	SEP	SES	TR	COR	COI	HU
Finland	-	**	*	-	-	-	-
Germany	-	**	*	-	-	-	-
Israel	-	-	*	-	-	-	-
Italy	-	**	*	-	-	-	-
New Zealand	-	**	*	-	-	-	-
Poland	-	**	*	-	-	-	-
Portugal	-	**	*	-	-	-	-
Switzerland	-	-	*	-	-	-	-

Summary

Conservation

Exact MI
** = full scalar MI
* = partial scalar MI
- = lack of scalar MI

Approximate MI

ok = scalar MI

	FAC	SEP	SES	TR	COR	COI	HU
Finland	ok	ok	ok	ok	ok	ok	ok
Germany	ok	ok	ok	ok	ok	ok	ok
Israel	ok	ok	ok	ok	ok	ok	ok
Italy	ok	ok	ok	ok	ok	ok	ok
New Zealand	ok	ok	ok	ok	ok	ok	ok
Poland	ok	ok	ok	ok	ok	ok	ok
Portugal	ok	ok	ok	ok	ok	ok	ok
Switzerland	ok	ok	ok	ok	ok	ok	ok

Summary

Self-transcendance

Exact MI
** = full scalar MI
* = partial scalar MI
- = lack of scalar MI

Approximate MI
ok = scalar MI

	UNN	UNC	UNT	BEC	BED
Finland	**	**	**	*	-
Germany	**	-	**	**	-
Israel	*	**	**	**	-
Italy	*	**	**	**	-
New Zealand	*	*	**	**	-
Poland	**	**	-	**	-
Portugal	**	*	-	**	-

Summary

Self-transcendance

Exact MI
** = full scalar MI
* = partial scalar MI
- = lack of scalar MI

Approximate MI
ok = scalar MI

	UN N	UNC	UNT	BEC	BE D
Finland	ok	ok	ok	ok	ok
Germany	ok	ok	ok	ok	ok
Israel	ok	ok	ok	ok	ok
Italy	ok	ok	ok	ok	ok
New Zealand	ok	ok	ok	ok	ok
Poland	ok	ok	ok	ok	ok
Portugal	ok	ok	ok	ok	ok

ESS sample sizes for the selected 15 countries over six ESS rounds (2002 - 2012)

	1st Round (2002/3)	2nd Round (2004/5)	3rd Round (2006/7)	4th Round (2008/9)	5th Round (2010/11)	6th Round (2012/13)	N
Belgium	1,899	1,778	1,798	1,760	1,704	1,869	10,808
Switzerland	2,040	2,141	1,804	1,819	1,506	1,493	10,803
Germany	2,919	2,870	2,916	2,751	3,031	2,958	17,445
Denmark	1,506	1,487	1,505	1,610	1,576	1,650	9,334
Spain	1,729	1,663	1,876	2,576	1,885	1,889	11,618
Finland	2,000	2,022	1,896	2,195	1,878	2,197	12,188
United Kingdom	2,052	1,897	2,394	2,352	2,422	2,286	13,403
Hungary	1,685	1,498	1,518	1,544	1,561	2,014	9,820
Ireland	2,046	2,286	1,800	1,764	2,576	2,628	13,100
Netherlands	2,364	1,881	1,889	1,778	1,829	1,845	11,586
Norway	2,036	1,760	1,750	1,549	1,548	1,624	10,267
Poland	2,110	1,716	1,721	1,619	1,751	1,898	10,815
Portugal	1,511	2,052	2,222	2,367	2,150	2,151	12,453
Sweden	1,999	1,948	1,927	1,830	1,497	1,847	11,048
Slovenia	1,519	1,442	1,476	1,286	1,403	1,257	8,383
N	29,415	28,441	28,492	28,800	28,317	29,606	173,071

STUDY 3 : UNIVERSALISM in the ESS over countries and time Points

Analytical steps for the exact and the approximate measurement invariance approaches

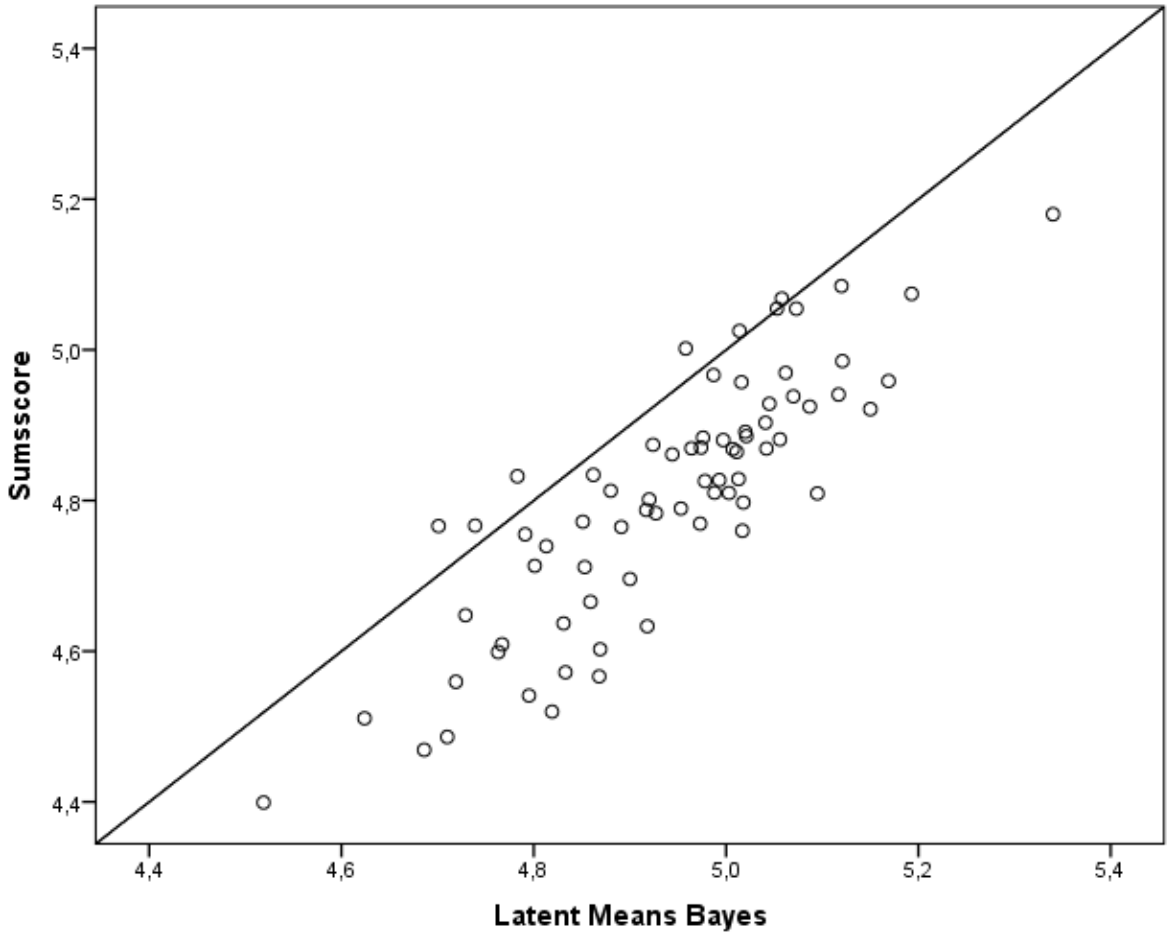
	Traditional exact approach	Approximate approach
Steps	1. Configural model 2. Metric model 3. Scalar model 4. Partial scalar model	1. Setting different informative priors for all loadings and intercepts 2. Releasing constraints on those loadings and intercepts which are different
Additional steps	5. Deleting groups which are not full or partial scalar invariant	3. Deleting groups which are not fully or partially approximately invariant

Global fit measures of the traditional exact approach

	Chi²(df)	RMSEA	SRMR	CFI	Countries/ Timepoints
Configural	0(0)	0	0	1	15
Round 1					
Metric	54.55(28)	0.023	0.028	0.995	15
Scalar	1040.47(56)	0.097	0.074	0.800	15
Partial Scalar	64.89(24)	0.029	0.029	0.985	8
Round 2					
Metric	45.23(28)	0.019	0.024	0.996	15
Scalar	1008.78(56)	0.098	0.070	0.800	15
Partial Scalar	53.28(28)	0.022	0.027	0.992	9
Round 3					
Metric	49.86(28)	0.021	0.025	0.995	15
Scalar	611.49(56)	0.074	0.061	0.883	15
Partial Scalar	53.78(27)	0.024	0.033	0.988	8
Round 4					
Metric	93.75(28)	0.036	0.035	0.987	15
Scalar	968.67(56)	0.094	0.073	0.823	15
Partial Scalar	87.43(24)	0.040	0.041	0.978	8
Round 5					
Metric	107.04(28)	0.039	0.037	0.985	15
Scalar	925.79(56)	0.092	0.074	0.839	15
Partial Scalar	90.10(21)	0.044	0.039	0.972	7
Round 6					
Metric	73.24(28)	0.029	0.030	0.990	15
Scalar	956.58(56)	0.091	0.069	0.808	15
Partial Scalar	69.26(21)	0.034	0.036	0.980	7
All rounds simultaneously					
Configural	0.395(0)	0	0.001	1	90
Metric	430.05(178)	0.028	0.030	0.992	90
Scalar	5723.51(356)	0.090	0.072	0.819	90
Partial Scalar	348.23(126)	0.031	0.035	0.983	37

[1]For the single rounds this refers to countries; for all rounds this is combination of country and time point.
Countries still included are: Belgium 2002-2012; Spain 2002-2006; Finland 2006-2010; United Kingdom 2012; Hungary 2002-2008; Ireland 2008, 2010; Netherlands 2002-2012; Norway 2004-2012; Poland 2006; Portugal 2004-2008; Sweden 2012; Slovenia 2002, 2006.

Relationship between sum scores and scores based on the Bayesian estimation in 73 country/time point combinations



AIC and BIC fit measures of the traditional exact approach

		AIC	BIC
Round 1	Metric	232453.884	233335.682
	Partial Scalar	133004.879	133373.601
Round 2	Metric	218452.710	219328.143
	Partial Scalar	134813.330	135221.803
Round 3	Metric	222284.379	223163.765
	Partial Scalar	106349.111	106687.021
Round 4	Metric	225469.593	226350.568
	Partial Scalar	109976.943	110337.466
Round 5	Metric	226639.903	227520.419
	Partial Scalar	98034.755	98344.903
Round 6	Metric	237036.130	237923.153
	Partial Scalar	113273.097	113589.931
All Rounds	Metric	1362329.608	1368665.132
	Partial Scalar	537676.482	539559.803

Global fit measures for the approximate invariance test

	ppp	ppp after releasing misspecified parameters
Round 1	0.048	0.049
Round 2	0.097	0.098
Round 3	0.126	0.127
Round 4	0.004	0.031
Round 5	0.001	0.005
Round 6	0.002	0.002
90 groups	0.000	0.000
73 groups	0.026	0.052

Note: ppp = posterior predictive probability

Correlations between latent means computed using sum scores (1), the exact (2) and the approximate (3) measurement invariance models for 73 county/time points

	Sum scores (1)	Exact test (2)	Approximate Bayesian test (3)
1	1		
2	.997**	1	
3	.851**	.844**	1

Conclusion

Bayesian analyses are promising.
They suggest approximate invariance
when stricter methods reject it; but need
for studies with Groups higher than 100
Need for more robustness studies
There is a need for more simulation studies
testing different conditions like

- **number of countries and time points and**
- **amount of misspecification**

Thank you for your attention!

This report was presented at the 5th LCSR International Annual Conference "Cultural and Economic Changes under Cross-national Perspective".

November 16 – 20, 2015 – Higher School of Economics, Moscow, Russia.

http://lcsr.hse.ru/en/conf2015

Настоящий доклад был представлен на V ежегодной международной конференции ЛССИ «Культурные и экономические изменения в сравнительной перспективе».

16-20 ноября 2015 года – НИУ ВШЭ, Москва, Россия.

http://lcsr.hse.ru/en/conf2015