

**Cross-Cultural  
Factor Analysis:  
Re-evaluation of  
a Metric Bias  
Reduction Method**

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## Factor structure equivalence

- ◆ In a satisfactory cross-cultural study, there is no variance left to be explained in terms of culture (Poortinga & Van de Vijver, 1987).
- ◆ Statistical methods have focused on bias detection and on bias elimination in order to achieve invariant scales across cultures.

## Accounting for cultural variance

- ◆ A biased item can be treated as a disturbance at the item level that has to be removed (Van de Vijver & Leung, 1997).
- ◆ Valencia, Rankin, & Livingston (1995) tried to account for cultural variance by controlling for age, gender and ability for an intelligence test through partial correlation coefficients; they found more than 50% of the items to be biased.
- ◆ A proposed method: Accounting for cultural variance by estimating for a set of items the amount of variance caused by "culture" using the information contained in these same items and not by using external measures (such as control variables).

## Assessing "variability" across cultures

### *Multidimensional Scaling techniques (Individual scaling)*

- ◆ Multidimensional scaling solutions can be computed for a set of countries to model cross-cultural similarities and differences.
- ◆ The *Individual Differences Euclidean Distance model* results into dimensions that are assumed to underlie a data set and vary in weight for different cultures (Van de Vijver & Leung, 1997).
- ◆ The proportionality of these weights to the average weights constitutes the "weirdness index" for each culture.

### *Previous studies*

Six-country comparison<sup>1</sup> of factor solutions before and after a metric correction based on the "weirdness" indices.

(<sup>1</sup> Mylonas, 2003, 6th Regional IACCP Congress, Budapest)

### *Aim of the study*

Attempt to replicate or falsify the six-country outcomes for multiple sets of combinations of n-countries, where n is 5 and 4.

Available measures (20 items, measurement scale: 1 to 6 , low to high)  
(data from Georgas et al.)

FATHER

provides emotional support  
keeps the family united  
keeps a pleasant environment  
conveys traditions to children  
conveys religion to children  
preserves family relations  
supports grandparents when in need  
takes care of grandparents (cooking, shopping)  
protects the family  
resolves disputes  
does housework  
does the shopping, pays bills, etc.  
takes children to school  
plays with children  
helps children with homework  
teaches manners to children  
contributes financially  
manages finances  
gives pocket money to children  
supports career of children

Countries in the analysis

*Six-country paradigm*

Greece (N=350)

Georgia (N=200)

USA (N=263)

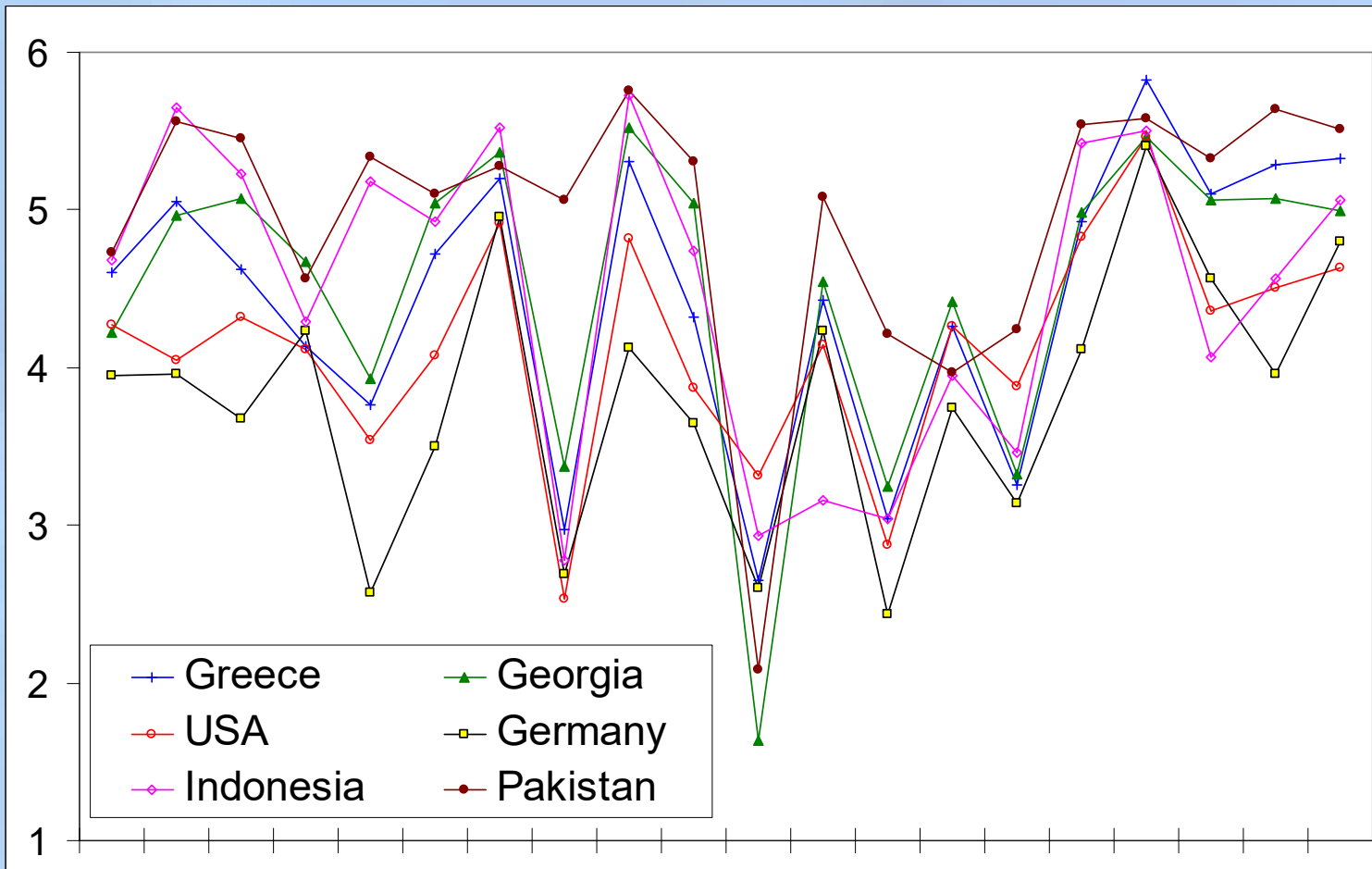
Germany (N=153)

Indonesia (N=239)

Pakistan (N=450)

*Current study*

**Groups** of countries in **ALL** combinations of 5  
and 4 countries in each group  
e.g. Greece, Georgia, Germany, Indonesia  
or, USA, Georgia, Pakistan, Germany, Indonesia



Means for each of the 20 father's roles for each of the six countries (raw data)

## Multilevel Covariance Structure Analysis and Multidimensional Scaling (Individual Differences Solutions)

Muthén (1994): Multilevel covariance structure analysis extended to exploratory factor analysis (Van de Vijver & Poortinga, 2002).

Two factor structures in the analysis:

Pooled within correlation matrix factor structure

Between groups correlation matrix factor structure

*Procrustian rotation* → Target rotated overall factor structure

**Final 'overall' factor structure ("stage 1 factor structure") retained for further comparisons.**

MDS solution - 6 dimensions - Individual Differences Euclidean Distance models - Computation of weirdness indices (one per country)

Metric adjustment<sup>2</sup> of the initial scores according to weirdness indices

Multilevel covariance structure analysis, *Procrustian rotation* → Target rotated **Final 'overall' factor structure ("stage 2 factor structure") retained for further comparisons.**

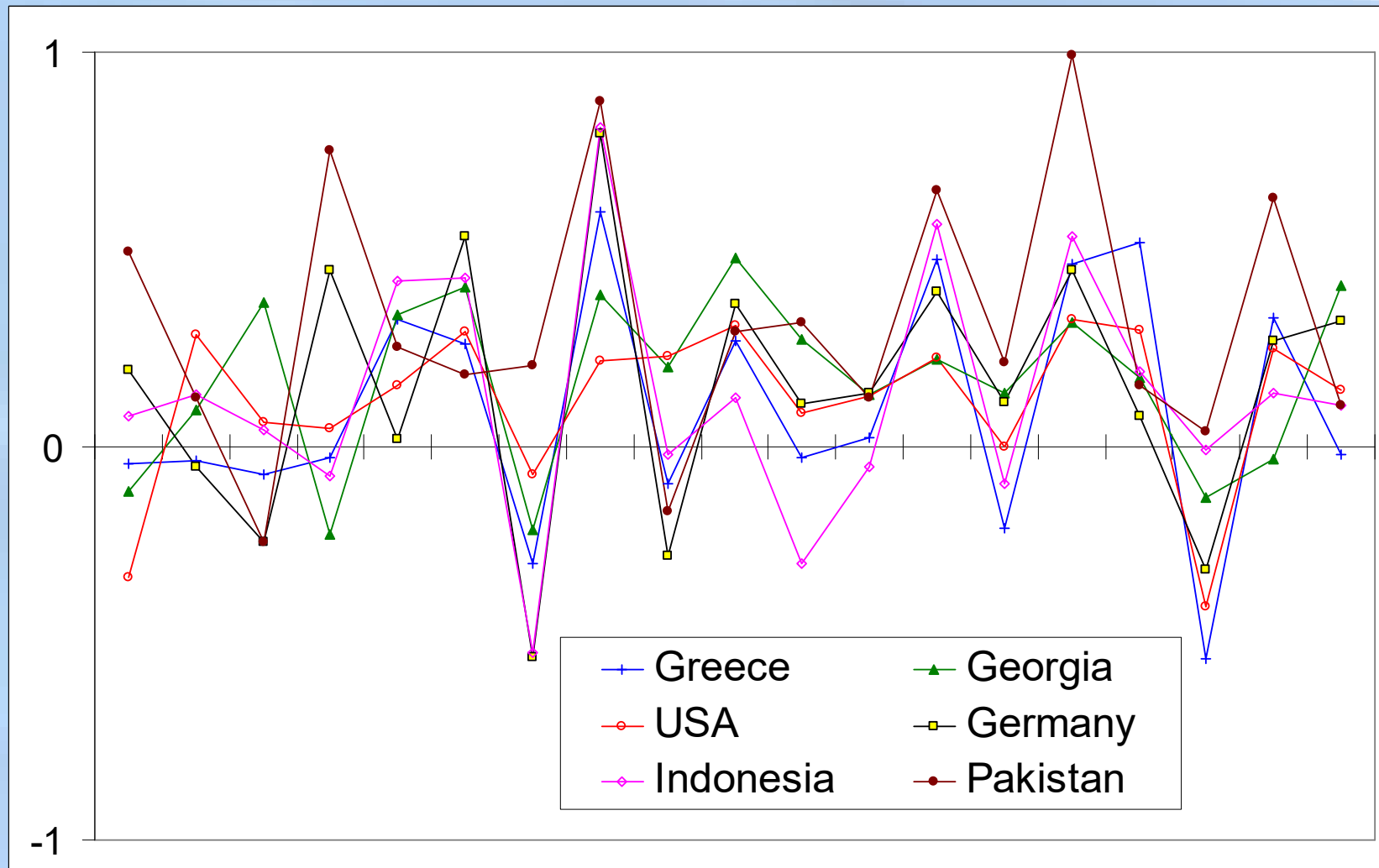
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$$z = \frac{X - \bar{X}}{s}$$

$$s' = \sqrt{s^2 - s^2 r^2}$$

$r^2$  is the weirdness index for each country employed as an index of "cultural effect size"

$$zs' + \bar{X} = X'$$
$$\bar{X}' = \bar{X} \text{ and } R' \neq R$$



Differences between the observed standard deviations and the "adjusted for weirdness" standard deviations for each of the 20 father's roles for the six countries

## Six countries "overall" factor structures **before** and **after** metric adjustment

Father	Stage 1 Factor Structure			Stage 2 Factor Structure		
provides emotional support	<b>.68</b>	.19	.14	<b>.69</b>	.16	.20
keeps the family united	<b>.77</b>	.31	.00	<b>.77</b>	.32	-.01
keeps a pleasant environment	<b>.77</b>	.25	.14	<b>.78</b>	.28	.10
conveys traditions to children	<b>.57</b>	.01	<b>.38</b>	<b>.57</b>	.04	.33
conveys religion to children	<b>.65</b>	.14	.13	<b>.66</b>	.22	.02
preserves family relations	<b>.69</b>	.26	.15	<b>.69</b>	.31	.11
supports grandparents when in need	<b>.53</b>	.26	-.05	<b>.55</b>	.23	.02
takes care of grandparents (cooking, shopping)	<b>.27</b>	<b>.27</b>	<b>.14</b>	<b>.32</b>	<b>.44</b>	<b>.05</b>
protects the family	<b>.63</b>	<b>.47</b>	-.04	<b>.66</b>	<b>.44</b>	-.03
resolves disputes	<b>.50</b>	<b>.40</b>	.04	<b>.49</b>	<b>.48</b>	-.04
does housework	.01	-.15	<b>.55</b>	.03	-.31	<b>.61</b>
does the shopping, pays bills, etc.	-.03	<b>.55</b>	<b>.55</b>	-.05	<b>.61</b>	<b>.51</b>
takes children to school	.22	.22	<b>.60</b>	.22	.33	<b>.47</b>
plays with children	<b>.39</b>	.04	<b>.57</b>	<b>.41</b>	.01	<b>.62</b>
helps children with homework	.36	.14	<b>.65</b>	.36	.17	<b>.62</b>
teaches manners to children	<b>.64</b>	.35	.20	<b>.66</b>	.33	.22
contributes financially	.16	<b>.65</b>	.03	.19	<b>.52</b>	.16
manages finances	.03	<b>.77</b>	.21	.03	<b>.77</b>	.22
gives pocket money to children	.29	<b>.67</b>	.18	.29	<b>.67</b>	.19
supports career of children	.36	<b>.53</b>	.13	.36	<b>.50</b>	.19



## Four countries (Gr, D, Ge, P) "overall" factor structures before and after madj

Although Tucker Phi coefficients indicate maximum factor equivalence for the before and after solutions there seem to be quite a few changes in the factor meanings that might better clarify the final structure

	Stage 1 Factor Structure			Stage 2 Factor Structure		
<b>Father</b>						
provides emotional support	<b>.58</b>	.22	.18	.40	<b>.45</b>	.29
keeps the family united	<b>.71</b>	.31	.21	<b>.69</b>	<b>.42</b>	.19
keeps a pleasant environment	<b>.72</b>	.23	.31	<b>.75</b>	.31	.22
conveys traditions to children	<b>.44</b>	-.03	<b>.48</b>	<b>.39</b>	.03	<b>.45</b>
conveys religion to children	<b>.56</b>	.18	.38	<b>.79</b>	.08	.24
preserves family relations	<b>.63</b>	.23	.3	<b>.62</b>	.37	.22
supports grandparents when in need	<b>.48</b>	.28	-.08	<b>.26</b>	<b>.48</b>	.06
takes care of grandparents (cooking, shopping)	<b>.53</b>	.10	.18	<b>.71</b>	-.01	.17
protects the family	<b>.59</b>	<b>.48</b>	.06	<b>.68</b>	<b>.46</b>	.02
resolves disputes	<b>.55</b>	.31	.15	<b>.77</b>	.15	.01
does housework	-.24	.10	<b>.46</b>	<b>-.39</b>	.19	<b>.62</b>
does the shopping, pays bills, etc.	-.04	<b>.50</b>	<b>.51</b>	.29	<b>.24</b>	<b>.47</b>
takes children to school	.13	.20	<b>.68</b>	<b>.54</b>	-.02	<b>.48</b>
plays with children	.22	.08	<b>.58</b>	.08	.3	<b>.57</b>
helps children with homework	.22	.16	<b>.70</b>	<b>.46</b>	.02	<b>.61</b>
teaches manners to children	<b>.57</b>	.38	.3	<b>.68</b>	.35	.23
contributes financially	.04	<b>.73</b>	-.11	-.03	<b>.79</b>	-.03
manages finances	.07	<b>.72</b>	.14	.31	<b>.56</b>	.07
gives pocket money to children	.29	<b>.66</b>	.16	<b>.52</b>	<b>.55</b>	.1
supports career of children	.31	<b>.53</b>	.18	.35	<b>.54</b>	.17

## Five countries (Gr,D,U,I,P) "overall" factor structures before and after madj

*Tucker Phi coefficients indicate factor equivalence for 2 of the 3 factors for the before-after solutions; however there are quite a few changes in the factor meanings*

*that alter the interpretation of the final structure*

	Stage 1 Factor Structure			Stage 2 Factor Structure		
<b>Father</b>						
provides emotional support	<b>.68</b>	.22	.14	<b>.74</b>	.16	.26
keeps the family united	<b>.76</b>	.31	.01	<b>.81</b>	.34	-.04
keeps a pleasant environment	<b>.77</b>	.25	.16	<b>.81</b>	.34	.05
conveys traditions to children	<b>.56</b>	-.02	<b>.41</b>	<b>.51</b>	.12	<b>.30</b>
conveys religion to children	<b>.67</b>	.19	.10	<b>.71</b>	.38	-.15
preserves family relations	<b>.70</b>	.25	.17	<b>.72</b>	.34	.11
supports grandparents when in need	<b>.52</b>	.25	-.04	<b>.58</b>	.09	.16
takes care of grandparents (cooking, shopping)	.36	.32	.14	.31	<b>.69</b>	-.07
protects the family	<b>.64</b>	<b>.48</b>	-.02	<b>.75</b>	<b>.37</b>	.05
resolves disputes	<b>.51</b>	<b>.42</b>	.07	<b>.56</b>	<b>.56</b>	-.09
does housework	.01	-.18	<b>.56</b>	.04	<b>-.46</b>	<b>.57</b>
does the shopping, pays bills, etc.	-.05	<b>.54</b>	<b>.58</b>	-.10	<b>.69</b>	<b>.49</b>
takes children to school	.22	.23	<b>.58</b>	.28	<b>.58</b>	<b>.19</b>
plays with children	.37	.02	<b>.60</b>	.35	-.09	<b>.71</b>
helps children with homework	.37	.16	<b>.62</b>	.34	.32	<b>.45</b>
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manages finances	.01	<b>.74</b>	.26	.02	<b>.71</b>	.36
gives pocket money to children	.27	<b>.67</b>	.19	.32	<b>.68</b>	.24
supports career of children	.35	<b>.55</b>	.14	<b>.39</b>	<b>.49</b>	.25

## Results for all 21 country combinations & in respect to factor equivalence

1. Mean difference in number of items participating in the factor structures ("after" minus "before" solutions) = 1.57 (that is, 1 - 2 items more), range: -2 to 6.
2. In 29% of the country combinations, at least one item were lost in the way  
In 19% of the country combinations, metric adjustment did not have an effect on the number of items participating in the structures  
In 52% of the country combinations, at least one item not loading on any factor for the "before" solution was now loading on a factor for the "after" solution.
3. Mean number of items with higher loadings in the "after" solution = 8.19  
Mean number of items with lower loadings in the "after" solution = 3.05  
Mean number of items adding to factor clarity in the "after" solution = 1.52
4. For all 21 country combinations collapsed, mean loading on each of the three factors per stage (before & after): Factor 1 (.62, .65), Factor 2 (.59, .60), Factor 3 (.57, .57).  
Through a double repeated measures design,  $F(1, 20) = 6.63, p < .05, \eta^2 = .25$ .
5. Tucker Phi indices as computed for each before-after pair separately, indicate 68% overall factor identity, 21% factor similarity and 11% factor dissimilarity.

*Thank you*

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