

Measurement Invariance of the Dirty Dozen: Student and Working Adult Samples

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Abstract

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words “**here we show**” or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline.

Keywords: keywords

Word count: X

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Methods

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study.

Participants

In total 1106 individuals responded to the Dirty Dozen (as well as additional scales not the focus of the current presentation). This total was comprised of 208 working adults low-stakes, 527 working adults high-stakes, and 371 students low-stakes individuals. After screening for undifferentiated responses via the R package **careless** (Yentes & Wilhelm, 2021), we retained 1054 respondents who had no more than 6 undifferentiated similar responses across the 12 total items.

Material**Procedure****Data analysis**

We used R [Version 4.0.5; R Core Team (2021)] and the R-packages *careless* [Version 1.2.1; Yentes and Wilhelm (2021)], *foreign* [Version 0.8.81; R Core Team (2020)], *lavaan* [Version 0.6.8; Rosseel (2012)], *papaja* [Version 0.1.0.9997; Aust and Barth (2020)], and *semTools* [Version 0.5.5; Jorgensen, Pornprasertmanit, Schoemann, and Rosseel (2021)] for all our analyses.

Results**##****## Measurement invariance models:****##**

```

51 ## Model 1 : fit.configural
52 ## Model 2 : fit.loadings
53 ## Model 3 : fit.intercepts
54 ## Model 4 : fit.means
55 ##
56 ## Chi-Squared Difference Test
57 ##
58 ##           Df    AIC    BIC  Chisq Chisq diff Df diff Pr(>Chisq)
59 ## fit.configural 153 37059 37640 1407.7
60 ## fit.loadings   171 37135 37626 1518.9      111.25      18 1.837e-15 ***
61 ## fit.intercepts 189 37230 37632 1650.5      131.54      18 < 2.2e-16 ***
62 ## fit.means      195 37344 37716 1775.9      125.40       6 < 2.2e-16 ***
63 ## ---
64 ## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
65 ##
66 ##
67 ## Fit measures:
68 ##
69 ##           cfi rmsea cfi.delta rmsea.delta
70 ## fit.configural 0.641 0.153      NA      NA
71 ## fit.loadings   0.615 0.150      0.027      0.003
72 ## fit.intercepts 0.582 0.148      0.032      0.001
73 ## fit.means      0.548 0.152      0.034      0.004
74 ## lavaan 0.6-8 ended normally after 108 iterations
75 ##
76 ##      Estimator                      ML
77 ##      Optimization method          NLMINB

```

78	##	Number of model parameters	117
79	##		
80	##	Number of observations per group:	
81	##	working adults low-stakes	191
82	##	working adults high-stakes	510
83	##	students low-stakes	351
84	##		
85	##	Model Test User Model:	
86	##		
87	##	Test statistic	1407.674
88	##	Degrees of freedom	153
89	##	P-value (Chi-square)	0.000
90	##	Test statistic for each group:	
91	##	working adults low-stakes	182.467
92	##	working adults high-stakes	523.812
93	##	students low-stakes	701.395
94	##		
95	##	Model Test Baseline Model:	
96	##		
97	##	Test statistic	3696.466
98	##	Degrees of freedom	198
99	##	P-value	0.000
100	##		
101	##	User Model versus Baseline Model:	
102	##		
103	##	Comparative Fit Index (CFI)	0.641
104	##	Tucker-Lewis Index (TLI)	0.536

```

105  ##
106  ## Loglikelihood and Information Criteria:
107  ##
108  ##   Loglikelihood user model (H0)           -18412.727
109  ##   Loglikelihood unrestricted model (H1)    -17708.890
110  ##
111  ##   Akaike (AIC)                           37059.454
112  ##   Bayesian (BIC)                         37639.593
113  ##   Sample-size adjusted Bayesian (BIC)      37267.983
114  ##
115  ## Root Mean Square Error of Approximation:
116  ##
117  ##   RMSEA                                0.153
118  ##   90 Percent confidence interval - lower    0.146
119  ##   90 Percent confidence interval - upper    0.160
120  ##   P-value RMSEA <= 0.05                  0.000
121  ##
122  ## Standardized Root Mean Square Residual:
123  ##
124  ##   SRMR                                0.110
125  ##
126  ## Parameter Estimates:
127  ##
128  ##   Standard errors                      Standard
129  ##   Information                          Expected
130  ##   Information saturated (h1) model        Structured
131  ##

```

```

132 ##
133 ## Group 1 [working adults low-stakes]:
134 ##
135 ## Latent Variables:
136 ##           Estimate   Std.Err   z-value   P(>|z|)
137 ##   mach =~
138 ##       A30           1.000
139 ##       A31           0.392     0.095     4.111     0.000
140 ##       A32           0.224     0.096     2.332     0.020
141 ##       A33           0.538     0.063     8.507     0.000
142 ##   narc =~
143 ##       A34           1.000
144 ##       A35           0.262     0.263     0.996     0.319
145 ##       A36           1.982     0.367     5.394     0.000
146 ##       A37           1.752     0.332     5.277     0.000
147 ##   psyc =~
148 ##       A38           1.000
149 ##       A39           1.328     0.240     5.541     0.000
150 ##       A40           0.820     0.195     4.196     0.000
151 ##       A41           0.814     0.205     3.969     0.000
152 ##
153 ## Covariances:
154 ##           Estimate   Std.Err   z-value   P(>|z|)
155 ##   mach ~~
156 ##       narc           0.311     0.066     4.691     0.000
157 ##       psyc           0.700     0.144     4.859     0.000
158 ##   narc ~~

```

159	##	psyc	0.251	0.065	3.863	0.000
160	##					
161	##	Intercepts:				
162	##		Estimate	Std.Err	z-value	P(> z)
163	##	.A30	1.948	0.089	21.789	0.000
164	##	.A31	1.901	0.083	22.999	0.000
165	##	.A32	4.607	0.083	55.484	0.000
166	##	.A33	1.340	0.056	24.095	0.000
167	##	.A34	1.393	0.061	22.680	0.000
168	##	.A35	4.267	0.091	46.791	0.000
169	##	.A36	1.890	0.083	22.892	0.000
170	##	.A37	1.508	0.078	19.429	0.000
171	##	.A38	2.984	0.122	24.507	0.000
172	##	.A39	1.759	0.087	20.119	0.000
173	##	.A40	2.031	0.100	20.231	0.000
174	##	.A41	3.288	0.109	30.174	0.000
175	##	mach	0.000			
176	##	narc	0.000			
177	##	psyc	0.000			
178	##					
179	##	Variances:				
180	##		Estimate	Std.Err	z-value	P(> z)
181	##	.A30	0.678	0.099	6.865	0.000
182	##	.A31	1.174	0.122	9.608	0.000
183	##	.A32	1.274	0.131	9.725	0.000
184	##	.A33	0.345	0.041	8.401	0.000
185	##	.A34	0.562	0.063	8.951	0.000


```

186 ##      .A35              1.578    0.162    9.753    0.000
187 ##      .A36              0.682    0.099    6.890    0.000
188 ##      .A37              0.666    0.088    7.523    0.000
189 ##      .A38              2.350    0.247    9.509    0.000
190 ##      .A39              0.610    0.098    6.251    0.000
191 ##      .A40              1.601    0.168    9.514    0.000
192 ##      .A41              1.948    0.204    9.572    0.000
193 ##      mach              0.848    0.157    5.419    0.000
194 ##      narc              0.158    0.052    3.008    0.003
195 ##      psyc              0.482    0.172    2.812    0.005
196 ##
197 ##
198 ## Group 2 [working adults high-stakes]:
199 ##
200 ## Latent Variables:
201 ##              Estimate  Std.Err  z-value  P(>|z|)
202 ##      mach =~
203 ##      A30              1.000
204 ##      A31              0.495    0.059    8.361    0.000
205 ##      A32              0.152    0.060    2.537    0.011
206 ##      A33              0.398    0.031   12.716    0.000
207 ##      narc =~
208 ##      A34              1.000
209 ##      A35              0.377    0.148    2.544    0.011
210 ##      A36              1.683    0.188    8.946    0.000
211 ##      A37              0.622    0.098    6.323    0.000
212 ##      psyc =~

```

```

213 ##      A38              1.000
214 ##      A39              1.148      0.139      8.287      0.000
215 ##      A40              0.408      0.087      4.692      0.000
216 ##      A41              0.864      0.142      6.100      0.000
217 ##
218 ## Covariances:
219 ##              Estimate Std.Err  z-value  P(>|z|)
220 ##  mach ~~
221 ##      narc              0.336      0.038      8.881      0.000
222 ##      psyc              0.579      0.079      7.293      0.000
223 ##  narc ~~
224 ##      psyc              0.251      0.039      6.388      0.000
225 ##
226 ## Intercepts:
227 ##              Estimate Std.Err  z-value  P(>|z|)
228 ##      .A30              1.761      0.050     34.986      0.000
229 ##      .A31              1.727      0.047     36.930      0.000
230 ##      .A32              4.788      0.047    101.300      0.000
231 ##      .A33              1.204      0.025     48.421      0.000
232 ##      .A34              1.224      0.033     36.737      0.000
233 ##      .A35              4.422      0.050     87.885      0.000
234 ##      .A36              1.825      0.050     36.532      0.000
235 ##      .A37              1.198      0.030     39.522      0.000
236 ##      .A38              3.076      0.075     40.922      0.000
237 ##      .A39              1.539      0.044     35.365      0.000
238 ##      .A40              1.557      0.048     32.693      0.000
239 ##      .A41              2.800      0.069     40.364      0.000

```

```

240 ##      mach      0.000
241 ##      narc      0.000
242 ##      psyc      0.000
243 ##
244 ## Variances:
245 ##              Estimate Std.Err  z-value  P(>|z|)
246 ##      .A30          0.564    0.053   10.564    0.000
247 ##      .A31          0.938    0.061   15.403    0.000
248 ##      .A32          1.123    0.070   15.926    0.000
249 ##      .A33          0.200    0.014   14.029    0.000
250 ##      .A34          0.434    0.030   14.306    0.000
251 ##      .A35          1.272    0.080   15.941    0.000
252 ##      .A36          0.902    0.068   13.291    0.000
253 ##      .A37          0.418    0.027   15.564    0.000
254 ##      .A38          2.415    0.158   15.304    0.000
255 ##      .A39          0.350    0.048    7.324    0.000
256 ##      .A40          1.079    0.069   15.726    0.000
257 ##      .A41          2.105    0.137   15.401    0.000
258 ##      mach          0.728    0.083    8.767    0.000
259 ##      narc          0.131    0.026    4.974    0.000
260 ##      psyc          0.468    0.108    4.315    0.000
261 ##
262 ##
263 ## Group 3 [students low-stakes]:
264 ##
265 ## Latent Variables:
266 ##              Estimate Std.Err  z-value  P(>|z|)

```

```

267 ##    mach =~
268 ##        A30                1.000
269 ##        A31                0.322    0.076    4.220    0.000
270 ##        A32                0.424    0.063    6.764    0.000
271 ##        A33                0.854    0.078   10.963    0.000
272 ##    narc =~
273 ##        A34                1.000
274 ##        A35                1.286    0.240    5.359    0.000
275 ##        A36                1.756    0.300    5.853    0.000
276 ##        A37                1.486    0.276    5.387    0.000
277 ##    psyc =~
278 ##        A38                1.000
279 ##        A39                1.430    0.150    9.551    0.000
280 ##        A40                0.785    0.119    6.627    0.000
281 ##        A41                1.130    0.140    8.083    0.000
282 ##
283 ## Covariances:
284 ##                Estimate Std.Err  z-value  P(>|z|)
285 ##    mach ~~
286 ##        narc                0.433    0.076    5.678    0.000
287 ##        psyc                0.794    0.105    7.585    0.000
288 ##    narc ~~
289 ##        psyc                0.326    0.060    5.403    0.000
290 ##
291 ## Intercepts:
292 ##                Estimate Std.Err  z-value  P(>|z|)
293 ##    .A30                    2.627    0.082   31.924    0.000

```

294	##	.A31	2.316	0.072	32.342	0.000
295	##	.A32	4.826	0.057	84.238	0.000
296	##	.A33	1.801	0.066	27.348	0.000
297	##	.A34	1.638	0.063	26.055	0.000
298	##	.A35	4.490	0.063	70.785	0.000
299	##	.A36	2.083	0.067	30.984	0.000
300	##	.A37	1.892	0.072	26.127	0.000
301	##	.A38	3.903	0.073	53.138	0.000
302	##	.A39	2.205	0.074	29.698	0.000
303	##	.A40	1.829	0.072	25.382	0.000
304	##	.A41	3.903	0.078	49.869	0.000
305	##	mach	0.000			
306	##	narc	0.000			
307	##	psyc	0.000			
308	##					
309	##	Variances:				
310	##		Estimate	Std.Err	z-value	P(> z)
311	##	.A30	1.474	0.124	11.919	0.000
312	##	.A31	1.707	0.129	13.240	0.000
313	##	.A32	0.990	0.075	13.148	0.000
314	##	.A33	0.863	0.076	11.335	0.000
315	##	.A34	1.276	0.095	13.396	0.000
316	##	.A35	1.227	0.093	13.238	0.000
317	##	.A36	1.241	0.099	12.522	0.000
318	##	.A37	1.593	0.120	13.220	0.000
319	##	.A38	1.407	0.109	12.936	0.000
320	##	.A39	0.938	0.085	11.028	0.000

We looked at structural invariance as well as latent means (Meredith, 1993; Steinmetz, Schmidt, Tina-Booh, Wieczorek, & Schwartz, 2009).

328 Discussion

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