

# Sex differences in personality are larger in gender equal countries: Replicating and extending a surprising finding

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Sex differences in personality have been shown to be larger in more gender equal countries. We advance this research by using an extensive personality measure, the IPIP-NEO-120, with large country samples ( $N > 1000$ ), from 22 countries. Furthermore, to capture the multidimensionality of personality we measure sex differences with a multivariate effect size (Mahalanobis distance  $D$ ). Results indicate that past research, using univariate measures of effect size, have underestimated the size of between-country sex differences in personality. Confirming past research, there was a strong correlation ( $r = .69$ ) between a country's sex differences in personality and their Gender Equality Index. Additional analyses showed that women typically score higher than men on all five trait factors (Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness), and that these relative differences are larger in more gender equal countries. We speculate that as gender equality increases both men and women gravitate towards their traditional gender roles.

**Keywords:** Personality; Big five; Sex differences; Gender equality; Country comparisons.

Sex differences in personality are larger in more gender equal countries. This surprising finding has consistently been found in research examining cross-country differences in personality (Costa, Terracciano, & McCrae, 2001; McCrae & Terracciano, 2005; Schmitt, Realo, Voracek, & Allik, 2008). Social role theory (e.g., Wood & Eagly, 2002) struggles to account for this trend. This is because the pressure on divergent social roles should be lowest in more gender equal countries, thereby decreasing, rather than increasing, personality differences (Schmitt et al., 2008). Evolutionary perspectives (e.g., Schmitt et al., 2017) provide alternative accounts. These suggest that some sex differences are innate and have evolved to optimise the different roles carried out by men and women in our ancestral past. For example, male strengths and interests such as physical dispositions may be associated with protecting family and building homesteads, while female strengths and interests such as nurturing may be associated with caretaking of offspring and the elderly (Lippa, 2010). Consequently, one hypothesis is that such inherent differences could be amplified in societies where socially construed norms concerning gender roles are relaxed. The idea is that when men and women are free to express

individual characteristics in more unconstrained societies, sex differences may be enlarged. Alternative explanations, related to methodological concerns, such as lack of measurement invariance in trait dispositions, do not seem to be valid (Kajonius & Mac Giolla, 2017).

The current study aims to replicate the finding that sex differences in personality are larger in more gender equal countries. We advance previous research in two ways. First, we use an extensive, open-source scale (120-item) of the most used personality measure, the Five Factor Model (Goldberg et al., 2006), in combination with large country sample sizes ( $N > 1000$  per country). Previous research has typically availed of one or the other (cf. Costa et al., 2001; Schmitt et al., 2008). Second, we measure sex differences with the multivariate effect size Mahalanobis distance  $D$  (the multivariate generalization of Cohen's  $d$ ; Mahalanobis, 1936; Del Giudice, 2009). Most research has typically focused on analysing differences trait by trait, or, when obtaining an overall sex difference score, by simply averaging differences on separate traits (e.g., Costa et al., 2001; Schmitt et al., 2008). However, because personality is inherently multidimensional, such an approach may represent a

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gross underestimation of sex differences (Del Giudice, 2009). Experiencing others' personality is constituted by the gestalt that is formed through the combination of traits, and as such can only be captured by a multi-dimensional measure of effect size (e.g., Conroy-Beam, Buss, Pham, & Shackelford, 2015; Vianello, Schnabel, Sriram, & Nosek, 2013). In other words, many minute differences, when taken together, can produce substantial overall differences. The present study should provide one of the most informative measures of overall cross-country sex differences in personality to date.

## METHOD

### Participants and design

The data were a subset of a larger dataset ( $N = 619,150$ ) collected by a university website dedicated to research on personality (Johnson, 2014). We selected participants 19–69 years old, a range in which personality is known to be reasonably rank-order stable (Briley & Tucker-Drob, 2014), from countries with at least 1000 respondents, a suggested limit where factor loadings start to stabilise (Hirschfeld, Von Brachel, & Thielsch, 2014). This resulted in a total sample size of 130,602, with respondents from 22 countries. The sample consisted of 43% male ( $N = 55,334$ ) and 57% female ( $N = 75,268$ ) respondents, with a mean age of 28.0 years ( $SD = 9.2$ ). Participants were self-selected volunteers who found the website via search engines or word-of-mouth. The average time spent on the website was between 20 and 30 minutes. Before they could proceed to the questionnaire participants were required to actively indicate, by clicking an icon, that they had read the informed consent. The informed consent highlighted that all participation was voluntary, that the questionnaire would be time consuming, used for research purposes, and that careless responding would diminish the value of the data. No compensation was given to participants except for automated feedback on their personality. The only demographic information collected was age, sex and country of origin. For country of origin, participants were asked, "Please indicate the country to which you feel you belong to the most, whether by virtue of citizenship, length of residence, or acculturation." The methods were approved at the time of data collection by the institutional review board at Pennsylvania State University. The dataset is openly available at <https://osf.io/tbmh5/>.

### Measurements

#### Personality traits

Personality was measured using the IPIP-NEO, based on 120 items. This is an open-source adaptation of the

widely used NEO-PI-R (Costa & McCrae, 2008). The IPIP-NEO measures five broad trait factors (Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness) and 30 detailed facet traits, based on 120 items (see Appendix A for a short summary). The mean Cronbach's alpha reliability for the five trait factors were high (Neuroticism = .90, Extraversion = .89, Openness = .81, Agreeableness = .85, Conscientiousness = .90). Model fits for respective five trait factor structures were slightly above the common cutoff RMSEA = .05, and can be studied in more detail in Kajonius and Mac Giolla (2017).

#### Gender Gap Index

Gender equality for each country was measured by the Global Gender Gap Index (hence forth Gender Equality Index; Hausmann, Tyson, & Zahidi, 2011) by the World Economic Forum. The index is based on a set of economic, political, educational and health-based criteria, and ranges from 0 (*very high gender gap, and thus gender unequal*) to 1 (*very low gender gap, and thus gender equal*). To correspond with the period of data collection, a country's Gender Equality Index score in the current study was based on the average score from 2006 to 2011.

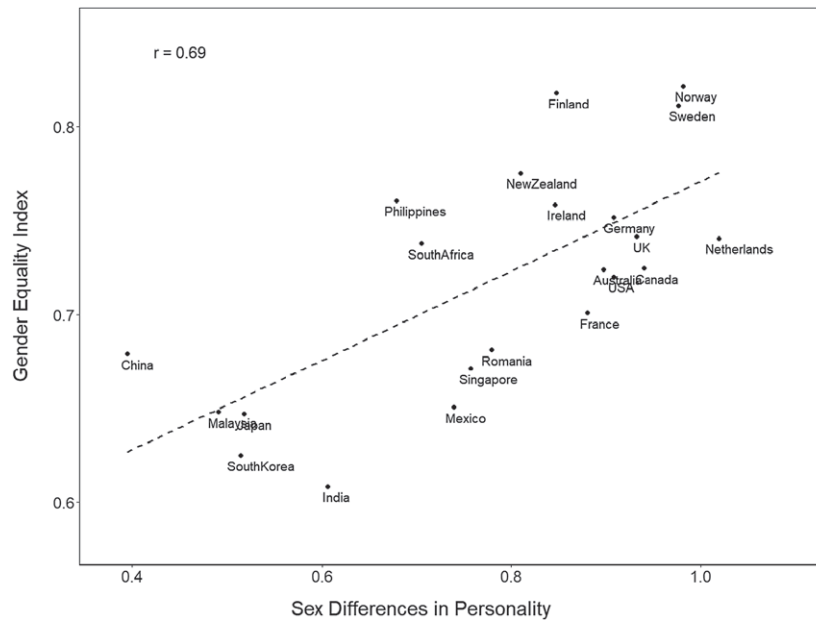
#### Statistical analysis

Duplicates (participants who took the test twice) and participants with repetitive patterns longer than 7-items were removed (<1% of the total sample). Missing data was corrected by using item means (<1% of the total sample).

A multivariate measure of sex differences (Mahalanobis  $D$ ) was calculated for each country using the script developed by Del Giudice (2009) for the statistics program **R** (R Core Team, 2017). Mahalanobis  $D$  provides a multivariate measure of the difference between two groups, and is represented in terms of standard deviation (as with Cohen's  $d$ ). In the current study,  $D$  was calculated from the correlation matrix of sex differences at the trait factor level (Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness). Hence, a  $D = 1$ , means two groups are one multivariate standard deviation apart in the distribution of the five factors.

## RESULTS

To test the underlying assumptions of  $D$ , Tucker's congruence coefficient ( $CC$ ) was used to assess the similarity of male and female correlation matrices. With the exception of Norway (Tucker's  $CC = .94$ ) all countries, had a Tucker's  $CC > .95$ , a suggested cut-off for a high degree of similarity (Lorenzo-Seva & Ten Berge, 2006). Heterogeneity in  $D$  was examined with the heterogeneity coefficient  $H_2$  (Del Giudice, 2018).  $H_2$  ranges from 0 to 1,



**Figure 1.** The correlation between country sex differences in personality and a country's gender equality. Increasing values on the X-axis indicate greater sex differences in personality, based on the multivariate measure of effect size Mahalanobis  $D$ . Increasing values on the Y-axis indicate greater gender equality.

where 1 indicates maximum heterogeneity. In the current context, a value of 1 would indicate that the observed  $D$  is fully determined by the contribution of just one trait. Lower values of  $D$  suggest a more even contribution of the variables to the observed multivariate effect. The mean  $H_2$  across countries was .68; ranging from .51 in Germany to .86 in China. Hence, in China the observed sex differences were determined by a small number of traits, while in Germany the contribution of traits to  $D$  was more even (for all country values see Appendix B).

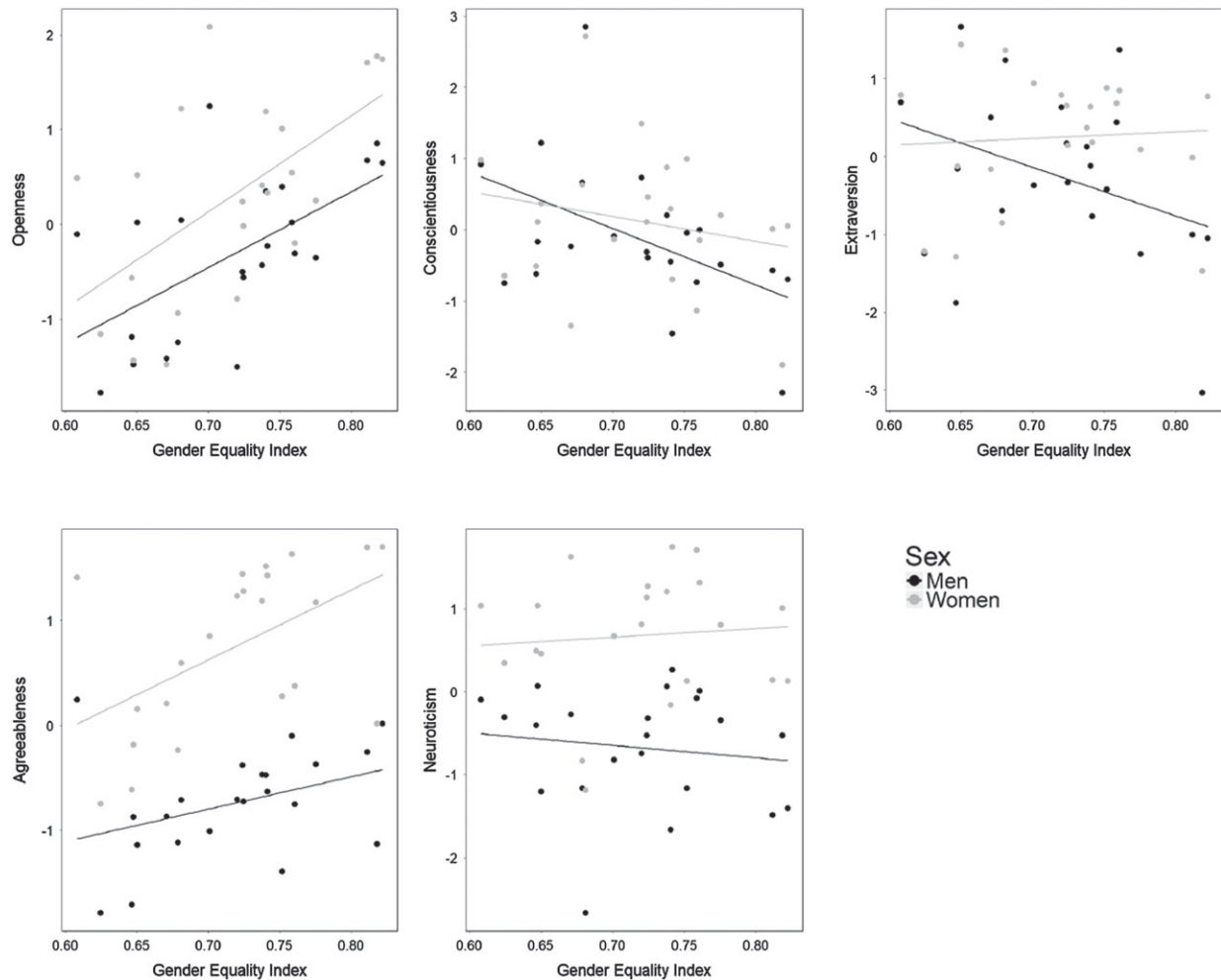
Values across countries for  $D$  varied substantially; ranging from 0.39 for China to 1.02 for the Netherlands. This means that in China men and women's average personality scores were less than half a multivariate standard deviation apart in the distribution of the five factors, whereas in the Netherlands, men and women's scores were over one standard multivariate deviation apart. Put differently, there was an 84% overlap between the personality profiles of men and women in China, but only a 61% overlap in the Netherlands. For comparative purposes with past research, we also calculated a univariate average sex difference index by averaging Cohen's  $d$  scores on the five factors ( $d_N + d_E + d_O + d_A + d_C / 5$ ) for each country. The range of between-country differences in personality on this index was markedly smaller, Cohen's  $d$  ranged from 0.11 to 0.32. This suggests that country sex differences in personality reported in past research may have been substantially underestimated.

Additional analyses examined the size of the difference in personality profiles when using (a) disattenuated

Cohen's  $d$  values ( $D_{Corrected}$ ) and (b) correlation matrices based on the 30 facets ( $D_{Facets}$ ) rather than the five traits.  $D_{Corrected}$  ranged from 0.47 to 1.17, while  $D_{Facets}$  ranged from 0.87 to 1.32. Hence, the uncorrected  $D$ , based on the correlation matrix of the five traits, may also be underestimating the size of the difference in personality profiles between men and women (for estimates for each country see Appendix B).

The main objective of the study was to examine the relationship between country sex differences in personality and a country's gender equality score. As predicted, and replicating past research, there was a significant correlation between the uncorrected  $D$  and country gender index scores,  $r(22) = .69$ , 95% CI [.38, .86],  $p < .001$ . This correlation is depicted with country names in Figure 1. Attesting to the robustness of the result, the correlation remained when gender index scores were correlated with  $D_{Corrected}$ ,  $r(22) = .70$ , 95% CI [.40, .87],  $p < .001$ ;  $D_{Facet}$ ,  $r(22) = .64$ , 95% CI [.30, .83],  $p < .001$ ; and the univariate average ( $d_N + d_E + d_O + d_A + d_C / 5$ ),  $r(22) = .66$ , 95% CI [.32, .84],  $p < .001$ .

To explore potential reasons for this finding, we also examined the trends between country-level average trait scores with country-level gender equality index scores, separately for men and women. Moderation analyses showed no significant effects of sex on the relationship between any of the big five traits and gender quality, all  $F$ s < 1.44, all  $p$ s > .23. Nonetheless, for exploratory purposes we examined the simple correlations between gender equality and each trait for both men and women (see Figure 2). Eyeballing Figure 2 shows a general trend



**Figure 2.** Correlations between country-level average trait scores and country-level gender equality separated for men and women. The y-axes show the standardised mean country scores for each of the big five traits.

of higher scores for women, relative to men on all five traits, and that this relative difference is larger in more gender equal countries. More specifically, gender equality was associated with higher scores for Openness for both men ( $r = .58, p = .004$ ) and women ( $r = .59, p = .004$ ). Similarly, gender equality was associated with higher scores for Agreeableness for both men ( $r = .32, p = .093$ ) and women ( $r = .52, p = .013$ ), with a somewhat stronger correlation observed for women. In contrast, gender equality was associated with lower scores in Conscientiousness for both men ( $r = -.48, p = .023$ ) and women ( $r = -.25, p = .333$ ), with a somewhat stronger correlation observed for men. For Extraversion, gender equality was associated with lower scores for men ( $r = -.35, p = .112$ ), but showed virtually no relationship for women ( $r = .06, p = .779$ ). Finally, gender equality showed a small negative correlation with Neuroticism for men ( $r = -.13, p = .564$ ), but a small positive correlation for women ( $r = .09, p = .707$ ). However, due to the small samples, and exploratory nature of these

analyses, these results should be interpreted with utmost caution.

## DISCUSSION

The current study represents the first examination of sex differences in personality across countries with large samples, using a multivariate measure of effect size (Mahalanobis  $D$ ). The results suggest that past studies, that averaged univariate measures of effect size (Cohen's  $d$ ), may have substantially underestimated the size of sex differences in personality profiles across countries. Sex differences were markedly higher when using a multivariate measure of effect size. Considering that personality is inherently multidimensional, in line with a growing number of researchers (e.g., Conroy-Beam et al., 2015; Del Giudice, 2009; Vianello et al., 2013), we propose that this represents a more accurate measure of the true difference.

Previous research has consistently demonstrated that higher levels of gender equality are associated with larger



sex differences in personality (Costa et al., 2001; Schmitt et al., 2008). The current study replicated this finding using a multivariate effect size. The relationship was remarkably high, with gender equality accounting for almost 50% of the variance in sex differences across countries. The exact reason for this finding remains unknown. Exploratory analyses, however, show some diverging trends for men and women at the trait level. For example, while mean country-levels of extraversion for women showed no relationship with the gender equality index, men were shown to have lower levels of extraversion in more gender equal societies. Future research could address this by looking at within-country variance and testing whether gender-equal attitudes on the individual level yield similar increases in sex differences in personality traits.

Two important limitations should be noted. First, the main analysis—the correlation between sex differences in personality and gender equality—was based on 22 data points, and should therefore be interpreted with caution. With that said, as the current finding is consistent with past research, this limitation would appear to be more relevant for estimations of the size of the effect, rather than its direction. Second, the gender equality index is highly intercorrelated with several measures of national progress, such as Gross Domestic Product (GDP) and the Human Development Index (Hausmann et al., 2011). Country-level sex differences in personality should therefore show similar correlations with these other national measures, as has been observed in previous research (Schmitt et al., 2008). We chose to focus on the gender equality index as we believe it is the most conceptually relevant national index for research focusing on sex differences. For more general limitations of research examining cross-country differences in personality see Kajonius and Mac Giolla (2017).

The results indicate that women are typically more worried (Neuroticism), social (Extraversion), inquisitive (Openness), caring (Agreeableness) and responsible (Conscientiousness) than men, and that these differences are larger in more gender equal countries. A possible explanation for this finding is that as gender equality increases both men and women gravitate towards their traditional gender roles. A combination of both social role theory and evolutionary perspectives may be needed to account for this curious result.

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**APPENDIX A**

**TABLE A**  
The five personality traits and their underlying facet traits of the IPIP-NEO-120

<i>Neuroticism</i>	<i>Extraversion</i>	<i>Openness</i>	<i>Agreeableness</i>	<i>Conscientiousness</i>
Anxiety	Friendliness	Imagination	Trust	Self-efficacy
<i>Worry about things</i>	<i>Make friends easily</i>	<i>Love to daydream</i>	<i>Trust others</i>	<i>Excel in what I do</i>
Anger	Gregarious	Artistic	Morality	Orderliness
<i>Get angry easily</i>	<i>Love large parties</i>	<i>Believe in the importance of art</i>	<i>Cheat to get ahead</i>	<i>Like to tidy up</i>
Depression	Assertive	Emotionality	Altruism	Dutifulness
<i>Often feel blue</i>	<i>Take charge</i>	<i>Feel other's emotions</i>	<i>Love to help others</i>	<i>Keep my promises</i>
Self-conscious	Activity	Adventurous	Cooperation	Achievement
<i>Find it difficult to approach others</i>	<i>Am always busy</i>	<i>Prefer variety to routine</i>	<i>Love a good fight</i>	<i>Work hard</i>
Immoderation	Excitement	Intellect	Modesty	Self-discipline
<i>Rarely overindulge</i>	<i>Love excitement</i>	<i>Love to read challenging material</i>	<i>Think highly of myself</i>	<i>Am always prepared</i>
Vulnerability	Cheerful	Liberalism	Sympathy	Cautiousness
<i>Panic easily</i>	<i>Radiate joy</i>	<i>Tend to vote for liberal political candidates</i>	<i>Sympathise with the homeless</i>	<i>Rush into things</i>

Note. Column headings indicate each of the five trait factors which are constituted by six facet traits. Examples of question items for each facet are given in italics.

**APPENDIX B**

**TABLE B1**  
Country-level sex differences for each trait, for the univariate index, and for the multivariate D

Country	GEI	Univariate measure of sex differences (d)						Multivariate measure of sex differences (D)					
		dO	dE	dA	dC	dN	dAverage	D	95% CI	OVL	CC	H <sub>2</sub>	D <sub>Corrected</sub>
Australia	0.72	-0.19	-0.07	-0.55	-0.08	-0.40	0.26	0.90	0.86; 0.93	0.65	0.99	0.67	1.01
Canada	0.72	-0.14	-0.07	-0.59	-0.16	-0.39	0.27	0.94	0.91; 0.97	0.64	0.99	0.68	1.07
China	0.68	-0.10	0.03	-0.32	0.01	-0.10	0.11	0.39	0.30; 0.47	0.84	0.98	0.86	0.47
Finland	0.82	-0.25	-0.23	-0.35	-0.07	-0.40	0.26	0.85	0.75; 0.94	0.67	0.97	0.59	0.97
France	0.70	-0.24	-0.2	-0.54	0.01	-0.40	0.28	0.88	0.75; 0.99	0.66	0.98	0.63	1.00
Germany	0.75	-0.16	-0.2	-0.52	-0.20	-0.35	0.29	0.91	0.79; 1.00	0.65	0.99	0.51	1.04
India	0.61	-0.17	-0.02	-0.37	-0.01	-0.30	0.17	0.61	0.54; 0.66	0.76	0.99	0.70	0.70
Ireland	0.76	-0.13	-0.04	-0.52	0.07	-0.41	0.23	0.85	0.76; 0.92	0.67	0.98	0.73	0.96
Japan	0.65	-0.17	-0.10	-0.35	-0.02	-0.25	0.18	0.52	0.36; 0.64	0.80	0.98	0.64	0.59
Malaysia	0.65	-0.01	-0.01	-0.23	-0.05	-0.27	0.11	0.49	0.38; 0.58	0.81	0.99	0.80	0.58
Mexico	0.65	-0.14	0.04	-0.39	0.16	-0.46	0.24	0.74	0.61; 0.85	0.71	0.99	0.78	0.86
Netherlands	0.74	-0.23	0.12	-0.68	-0.15	-0.42	0.32	1.02	0.93; 1.10	0.61	0.95	0.68	1.17
NewZealand	0.78	-0.16	-0.21	-0.47	-0.13	-0.29	0.25	0.81	0.73; 0.88	0.69	0.99	0.58	0.94
Norway	0.82	-0.28	-0.27	-0.52	-0.14	-0.41	0.32	0.98	0.84; 1.10	0.62	0.94	0.55	1.13
Philippines	0.76	-0.04	0.10	-0.36	0.03	-0.37	0.18	0.68	0.59; 0.75	0.73	0.99	0.76	0.79
Romania	0.68	-0.35	-0.02	-0.40	0.02	-0.37	0.23	0.78	0.65; 0.88	0.70	0.99	0.65	0.88
Singapore	0.67	0.02	0.12	-0.34	0.23	-0.54	0.25	0.76	0.70; 0.81	0.70	0.99	0.77	0.84
South Africa	0.74	-0.22	-0.04	-0.47	-0.12	-0.27	0.22	0.71	0.60; 0.80	0.72	0.97	0.62	0.79
South Korea	0.62	-0.18	-0.01	-0.36	-0.02	-0.21	0.16	0.51	0.40; 0.60	0.80	0.99	0.73	0.59
Sweden	0.81	-0.27	-0.14	-0.56	-0.11	-0.43	0.30	0.98	0.87; 1.07	0.63	0.98	0.60	1.11
UK	0.74	-0.14	-0.14	-0.60	-0.14	-0.35	0.28	0.93	0.90; 0.96	0.64	0.99	0.66	1.06
USA	0.72	-0.17	-0.02	-0.58	-0.14	-0.38	0.26	0.91	0.88; 0.93	0.65	0.99	0.69	1.03

Note. 95% CI = the lower and upper bound bootstrapped 95% CIs; CC = Tucker's congruence coefficient; D = Mahalanobis D based on the correlation matrices of the five traits; dO ... dN = sex differences for the five traits measured in Cohen's d (negative values imply higher scores for women); dAverage = the average of the d values of the five traits (all negative ds were converted to natural numbers before averaging); D<sub>Corrected</sub> = D corrected for attenuation; GEI = Gender Equality Index; H<sub>2</sub> = Heterogeneity coefficient H<sub>2</sub>; OVL = coefficient of overlap based on a single distribution.

**TABLE B2**  
Country-level multivariate measure of sex differences calculated from the 30 sub facets ( $D_{\text{Facets}}$ )

Country	GEI	$D_{\text{Facets}}$	95% CI	OVL	CC	$H_2$
Australia	0.72	1.17	1.13; 1.20	0.56	0.99	0.65
Canada	0.72	1.23	1.20; 1.26	0.54	0.99	0.59
China	0.68	0.90	0.78; 0.95	0.65	0.97	0.63
Finland	0.82	1.16	1.01; 1.22	0.56	0.96	0.63
France	0.70	1.25	1.08; 1.31	0.53	0.95	0.67
Germany	0.75	1.20	1.07; 1.27	0.55	0.97	0.60
India	0.61	1.04	1.07; 1.27	0.55	0.97	0.64
Ireland	0.76	1.10	1.00; 1.15	0.58	0.98	0.60
Japan	0.65	0.89	0.72; 0.93	0.66	0.95	0.65
Malaysia	0.65	0.87	0.73; 0.93	0.66	0.98	0.63
Mexico	0.65	1.00	0.85; 1.06	0.62	0.96	0.63
Netherlands	0.74	1.30	1.20; 1.36	0.52	0.97	0.69
NewZealand	0.78	1.09	0.98; 1.14	0.59	0.98	0.59
Norway	0.82	1.32	1.14; 1.39	0.51	0.96	0.63
Philippines	0.76	0.94	0.84; 1.00	0.64	0.99	0.66
Romania	0.68	1.13	0.98; 1.20	0.57	0.97	0.69
Singapore	0.67	1.13	1.06; 1.18	0.57	0.98	0.65
South Africa	0.74	1.20	1.06; 1.26	0.55	0.97	0.67
South Korea	0.62	0.92	0.80; 0.97	0.65	0.96	0.71
Sweden	0.81	1.32	1.18; 1.38	0.51	0.97	0.62
UK	0.74	1.21	1.18; 1.24	0.54	0.99	0.65
USA	0.72	1.25	1.22; 1.28	0.53	0.99	0.59

*Note.* 95% CI = the lower and upper bound bootstrapped 95% CIs; CC = Tucker's congruence coefficient;  $D_{\text{Facets}}$  = Mahalanobis  $D$  based on the correlation matrices of the 30 traits; GEI = Gender Equality Index;  $H_2$  = Heterogeneity coefficient  $H_2$ ; OVL = coefficient of overlap based on a single distribution.