

Research



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Sex differences in moral judgements across 67 countries

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Most of the empirical research on sex differences and cultural variations in morality has relied on within-culture analyses or small-scale cross-cultural data. To further broaden the scientific understanding of sex differences in morality, the current research relies on two international samples to provide the first large-scale examination of sex differences in moral judgements nested within cultures. Using a sample from 67 countries (Study 1; $n = 336\,691$), we found culturally variable sex differences in moral judgements, as conceptualized by Moral Foundations Theory. Women consistently scored higher than men on Care, Fairness, and Purity. By contrast, sex differences in Loyalty and Authority were negligible and highly variable across cultures. Country-level sex differences in moral judgements were also examined in relation to cultural, socioeconomic, and gender-equality indicators revealing that sex differences in moral judgements are larger in individualist, Western, and gender-equal societies. In Study 2 (19 countries; $n = 11\,969$), these results were largely replicated using Bayesian multi-level modelling in a distinct sample. The findings were robust when incorporating cultural non-independence of countries into the models. Specifically, women consistently showed higher concerns for Care, Fairness, and Purity in their moral judgements than did men. Sex differences in moral judgements were larger in individualist and gender-equal societies with more flexible social norms. We discuss the implications of these findings for the ongoing debate about the origin of sex differences and cultural variations in moral judgements as well as theoretical and pragmatic implications for moral and evolutionary psychology.

1. Introduction

Fundamental moral concerns such as care, fairness, ingroup loyalty, respect for authority, and purity govern human psychology across cultures [1]. A growing programme of research suggests that women and men endorse moral concerns and social preferences to different degrees and that these sex differences vary across cultures [2–5]. The most recent synthesis of research on culturally variable sex differences in different psychological characteristics indicates that evolutionary forces and social environments can explain how and why women and men differ on some characteristics [6]. However, well-powered cross-cultural studies on sex differences in moral judgements are lacking in the field. Here, we examine sex differences in moral judgements as conceptualized in Moral Foundations Theory [7] (i.e. Care, Fairness, Loyalty, Authority, and Purity) in two large-scale datasets. In addition, we investigate the relationship between country-level indices of cultural characteristics, socioeconomic development, and gender equality, in relation to the magnitude of sex differences in moral judgements.

Moral Foundations Theory [1,7] was developed by searching for the best links between anthropological and evolutionary accounts of morality across cultures. This theory posits that moral intuitions derive from innate psychological mechanisms that coevolved with cultural institutions. Each moral system produces fast, automatic gut-level reactions of like or dislike when certain

phenomena are perceived in the social world, which in turn guide judgements of right and wrong. These systems, according to MFT, have evolutionarily adaptive underpinnings present in all individuals. Indeed, cultural evolutionary processes (e.g. social learning) shape the mechanisms through which such intuitions translate into everyday moral judgements in social contexts [8]. These foundations concern dislike for the suffering of others (Care), proportional versus egalitarian fairness (Fairness), ingroup loyalty (Loyalty), deference to authority and tradition (Authority), and concerns with physical/spiritual purity and contamination (Purity). Care and Fairness are entailed in individuals' well-being and have been referred to as the 'individualizing' foundations. On the other hand, Loyalty, Authority, and Purity encompass concerns about community, social order, and the maintenance of group bonds and, therefore, have been referred to as the 'binding' foundations [9].

Although MFT was originally developed as an evolutionarily informed cultural theory of morality, it has been substantially applied to the study of political ideology, especially in the USA [10,11]. MFT provides a useful theoretical framework to examine cross-cultural variations in morality and how different cultures show differing patterns of sex differentiation in each moral foundation. Graham *et al.* [12] found in an international sample that women scored higher on Care, Fairness, and Purity, while men scored higher on Loyalty and Authority. These authors suggest that women's higher Care and Purity concerns can be rooted in their higher emotional empathy and disgust sensitivity. Graham *et al.* [12] did not, however, report global sex differences in moral judgements. In addition, it is not clear how robust these patterns are across cultures and how cultural variables attenuate sex differences in moral judgements.

Studies using multifaceted measurement of moral concerns have shown that while Western, Educated, Industrialized, Rich, and Democratic (WEIRD; [13]) cultures are generally more inclined to endorse moral codes emphasizing individual rights and independence, non-WEIRD cultures tend to more strongly moralize duty-based communal obligations and spiritual purity [14,15]. Cultures might be sensitive to the same types of social offences, but view them as religious violations rather than moral violations [15]. In turn, individuals in autonomy-endorsing cultures (e.g. the USA) view personal actions such as sexual behaviours as a matter of individual rights, whereas those in community-endorsing cultures (e.g. China) are more likely to see them as a collective moral concern [16]. Finally, it is less clear how women's and men's endorsement of different moral foundations covary with culture-wide characteristics such as WEIRDness, individualism, or cultural tightness (i.e. homogeneity in values, norms, and behaviours [17]).

Tight cultural norms are created and maintained to encourage social coordination that facilitates member survival in the face of social, historical, and ecological threats. This structured coordination can help to reduce potential risks encountered by populations living in regions with higher scarcity of resources, increased prevalence of natural disasters, or territorial threats [17]. The inter-society elasticity of moral judgements, cultural norms, and sacred values all relate to the roles men and women play in their societies. For example, in more tight cultures (e.g. Pakistan), social norms with respect to gender are expressed very clearly and unambiguously, and violators are expected to be punished, whereas in a loose culture (e.g.

Norway), non-conformist behaviours are tolerated. This is directly associated with gender roles in different societies. In more tight cultures, men and women have predefined roles which should be carefully observed or otherwise undergo societally imposed sanctions [17]. As such, it can be expected that women and men in loose cultures can more easily afford to 'diverge' in their judgements of right and wrong without being sanctioned or punished.

Two theoretical frameworks have provided explanations as to how and why sex differences in different psychological domains vary across cultures: (i) evolutionary psychology [18,19] and (ii) social role theory [20,21]. Evolutionary psychologists argue that the sexes differ in the domains in which women and men have faced different adaptive problems in their evolutionary history. Evolutionary theories of sex differences have been heavily influenced by research on sexual selection in humans and other animals [22]. Trivers' [23] Parental Investment Theory provided a strong theoretical framework regarding sex differences in human mating strategies. According to Parental Investment Theory, the relative proportion of parental investment varies between males and females and the sex that invests more in offspring is the 'chooser' one. In some species, males provide more parental investment (e.g. the Mormon cricket); however, in most mammals, females hold the heavy-investing parental burdens [24]. The lesser-investing sex (i.e. men in humans) tends to mate more quickly, at lower cost, and with more partners compared with the heavier-investing sex (women in humans) (see [25]). Documented human sex differences in short-term sexual relationships and motivation for extramarital mating are consistent with this account [26,27]. As such, sex differences in parental investment obligations appear to have influenced the evolution of mating strategies which can be manifested in men's and women's traits, motivations, and values. Based on this framework, women are particularly expected to endorse, more strongly than men, moral values that promote parental care and compassion toward offspring (e.g. Care) and moral values that prohibit unrestricted sociosexual orientation (e.g. Purity). Indeed, these differences are sensitive to socioecological and cultural factors. For example, historical transitions from food collection to food production may affect societies, including cultural coevolution between subsistence strategies and mating practices [22]; hence, the interaction of genetic and cultural evolution should be considered in examining culturally variable sex differences in moral judgements. Evolutionary psychologists have specifically argued that gender-egalitarian cultures (i.e. higher gender equality) provide an environment in which women and men are freer to express their evolved predispositions [18,28], producing *larger* sex differences.

In opposition to evolutionary psychology research on sex differences, Wood and Eagly's biosocial role theory locates the origin of sex differences in the roles women and men occupy in society. According to this theory, differences in upper-body strength and reproductive activities lead to a mode of division of labour driven by efficiency but with male-dominated roles yielding greater social status. Wood & Eagly [20] argue that proximal biological and social psychological processes dynamically create sex differences through shared beliefs within a society. Gender stereotypes and norms follow from people's observations of women and men in their social roles. This theoretical framework predicts *smaller* sex differences in gender-equal societies on those variables that are plausibly consequences of greater gender parity in the

division of labour (e.g. mate preferences for status/resources) [21] (also see Zhang *et al.* [29]).

In addition to the relationship between the magnitude of sex differences and gender equality as a country-level variable, an evolutionary psychological perspective can provide insights as to how other cultural variables covary with sex differences across countries. Since this perspective posits that cultural characteristics associated with freedom, individuality, equality, and looseness ‘unleash’ evolved sex differences, this framework would predict larger sex differences in individualist, WEIRD, and loose cultures where men and women can freely express their sex-differentiated preferences [2]. In addition, models of sexual selection predict that sex ratio, as an important ecological variable, can influence patterns of sex-differentiated investment in mating efforts [30]. In male-biased sex ratios (when men are relatively abundant), men shift their energy away from seeking multiple sexual partners, towards maintaining committed long-term relationships and parental care [31]. This likely occurs because the rarity of women decreases the frequency of short-term relationship opportunities for men and increases women’s ability to assert preferences for monogamous pair-bonding which, on average, are stronger in women than men [19,32]. Hence, if men redirect their efforts to meet preferences of women, in countries characterized by male-biased sex ratios, sex differences in moral domains that are related to reproductive strategies (e.g. Care and Purity; see [7]) should shrink.

The present research aims to examine culturally nested sex differences in moral judgements, as well as the relationship between cultural (i.e. WEIRDness, individualism, cultural tightness), socioeconomic (i.e. Gini coefficient, human development, life satisfaction), gender-related factors (i.e. gender gap and sex ratio), and the magnitude of sex differences in moral judgements across cultures. Relying on the MFT framework, we investigate culturally variable sex differences in Care, Fairness, Loyalty, Authority, and Purity. A multivariate measure of effect size is also used to better understand the link between multivariate (or global) sex differences in moral judgements and country-level indices [33]. Study 1 (67 cultures; 392 617) relies on a large, online sample. In order to address the limitations of online samples in Study 1 (see Yeager *et al.* [34]), we replicate these findings by secondary analysis of independent datasets in Study 2 (19 cultures; 11 969).

2. Study 1

In Study 1, the data were collected on an online research platform (YourMorals.org) for research on moral and political psychology. Participants were not monetarily compensated, but were given feedback on their moral scores compared with the larger community. Participants voluntarily visited the website and completed an array of surveys. A total of 392 617 individuals responded to a set of surveys. For the purposes of the current study, we pre-processed the data, removing those who did not complete the Moral Foundations Questionnaire (MFQ; [12]), which is the central measure of the study. The MFQ is a 30-item self-report measure of moral foundations. Across countries, the mean Cronbach’s α s were 0.69 (s.d. = 0.04), 0.63 (s.d. = 0.05), 0.72 (s.d. = 0.03), 0.72 (s.d. = 0.04), and 0.81 (s.d. = 0.03) for Care, Fairness, Loyalty, Authority, and Purity, respectively. Further, we removed those who did not report their sex. Of note, we did not measure participants’ gender identity or sexual orientation.

We kept data from countries for which we had at least 100 participants. Overall, the MFQ responses and self-reported sex from 336 691 participants from 67 countries were retained for statistical analysis. The median sample size was 439 per country. We also collected country-level data on (i) individualism (preference for a loosely knit social framework where individuals are expected to take care of only themselves and their immediate families) [35], (ii) cultural looseness (flexibility in social norms) [36], (iii) WEIRDness distance (country-level cultural distance from the USA as a point of comparison) [37], (iv) human development (a summary measure of achievements in three key dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living) [38], (v) overall life satisfaction (feelings about quality of life) [38], (vi) economic inequality (Gini coefficient: the amount of inequality that exists in a population) [38], (vii) gender gap (gender equity in access to resources and opportunities, a composite index including four factors addressing the domains of economics, education, politics, and health) [39], and (viii) sex ratio (population-level adult sex ratio of a society) [40]. More information on collection of these data can be found in the electronic supplementary material.

In Study 1, we use multi-level modelling (MLM) to examine the effect of sex on moral foundations across cultures. Before running the multi-level analyses, we tested both the item factor loadings and item intercepts for all foundations. Our Item-Response Theory (IRT) application of the Alignment method [41] provided evidence that moral foundations, as measured by MFQ, can be meaningfully compared across 67 cultures. Item loadings and intercepts were shown to be approximately invariant across groups and non-invariance indexes (Care: 6.8%, Fairness: 23.6%, Loyalty: 10.9%, Authority: 8.0%, and Purity: 8.0%) were all below the recommended 25% cut-off proposed by Muthén & Asparouhov [41]. Comprehensive results for establishing measurement invariance for all 67 cultures are presented in the electronic supplementary material. We report fixed-effect estimates with 95% confidence intervals (95% CI). First, we estimated moral foundation scores based on country (Model 0). Second, we estimated moral foundation scores based on sex as a fixed parameter, the sex differences were not allowed to vary across countries, resulting in the average sex difference (Model 1). Third, we estimated a random slope model allowing countries to vary in sex differences (Model 2). These steps were repeated for each moral foundation.

The MLM results for Care, Fairness, Loyalty, Authority, and Purity are presented in table 1 (visualizations available in the electronic supplementary material). The intraclass correlation coefficients (ICCs) were 0.02, 0.03, 0.07, 0.09, and 0.12, indicating that 2%, 3%, 7%, 9%, and 12% of the variance in Care, Fairness, Loyalty, Authority, and Purity were at the country-level, respectively. Since ICC quantifies the proportion of variance explained by a grouping (random) factor in hierarchical data, it can be inferred that 2, 3, 7, 9, and 12% of the variance in Care, Fairness, Loyalty, Authority, and Purity are attributable to country membership, before including sex in the model. It can be seen that sex differences in Care, Fairness, and Purity are relatively uniform across cultures, consistently favouring women. The magnitude of sex differences for Loyalty and Authority are mixed and highly variable across cultures.

As a robustness check, and to ensure that these findings are not contingent upon cultural and geographical non-independence of countries, we ran two sets of robustness

Table 1. Results of multi-level models (Study 1).

moral foundation	model	random effects			fixed effects		
		intercept variance (country)	slope variance (sex)	estimate (intercept)	s.e.	estimate (sex)	s.e.
Care	0	0.017		3.47**	0.02		
	1	0.019		3.78**	0.02	−0.51**	0.003
	2	0.020	0.015	3.75**	0.02	−0.45**	0.02
Fairness	0	0.018		3.65**	0.02		
	1	0.020		3.76**	0.02	−0.19**	0.003
	2	0.020	0.002	3.76**	0.02	−0.17**	0.01
Loyalty	0	0.056		2.40**	0.03		
	1	0.057		2.37**	0.03	0.06**	0.003
	2	0.066	0.004	2.42**	0.03	−0.03*	0.01
Authority	0	0.083		2.28**	0.04		
	1	0.082		2.28**	0.04	−0.01**	0.003
	2	0.096	0.003	2.28**	0.04	−0.003	0.01
Purity	0	0.168		1.75**	0.05		
	1	0.162		1.86**	0.05	−0.17**	0.004
	2	0.178	0.003	1.87**	0.05	−0.20**	0.01

* $p < 0.05$; ** $p < 0.01$.

checks for all foundations. In the first set of models, we ran three-level models where gender was clustered in countries and countries were clustered in six different world regions. In the second set of models, we used Phylogenetic Multi-Level Models [42] to incorporate cultural distance [37] of cultures studied (e.g. [43]). These models are relevant in evolutionary biology when data of many species are analysed at the same time; however, species are not independent as they come from the same phylogenetic tree and thus models have to be adjusted to incorporate this non-independence. Here, we accounted for non-independence of countries in the data by incorporating a quantitative and validated metric of cultural distance. In these analyses, we used Muthukrishna *et al.*'s [37] cultural distance metric to construct a distance matrix.¹ This metric is a theoretically defensible and robust method of measuring cultural distance, grounded in evolutionary theory. In our analyses to account for cultural non-independence of countries, we considered differences between distributions of cultural traits rather than point estimates or arbitrary dimensions [37]. Out of 67 countries in our sample, Muthukrishna *et al.* provided data for 47 countries. The phylogenetic tree based on this distance matrix (electronic supplementary material, figure S6) along with all Phylogenetic Multi-Level Models are fully described in the electronic supplementary material. Notably, none of these models was meaningfully different from the models described above indicating that the mentioned sex differences are robust to geographical and cultural dependencies of countries studied.

Further, we calculated Mahalanobis' D (and its 95% CI based on 10 000 bootstrap iterations), which estimates the size of global (i.e. multivariate) sex differences. Since D can overestimate sex differences in small samples and underestimate them when using unreliable measurements, we corrected for both biases by calculating disattenuated, bias-corrected difference,

known as D_{cu} [33]. Across 67 cultures, D_{cu} was large in size, $M = 0.76$, $Mdn = 0.76$, $s.d. = 0.21$. We examined the correlation coefficients between cultural, socioeconomic, gender-related variables, sex differences in moral foundations, and D_{cu} . The results of this analysis are summarized in table 2 with false discovery rate (FDR; a statistical approach used in multiple hypothesis testing to correct for multiple comparisons; the FDR is the proportion of the rejected null hypotheses which are erroneously rejected) correction of p -values. Global sex differences in moral judgements (D_{cu}) were larger in more individualist ($r = 0.39$, 95% CI [0.21, 0.55], FDR-adjusted $p < 0.001$), WEIRD ($r = 0.30$, 95% CI [0.06, 0.51], FDR-adjusted $p = 0.045$), and gender-equal (i.e. higher gender parity; $r = 0.27$, 95% CI [0.09, 0.46], FDR-adjusted $p = 0.019$) cultures. Since the Gender Gap Index has rightly been criticized, arguing that it is not intended to be used to explain outcomes causally [44], we replicated these correlations using the Gender Inequality Index [38]. The results were shown to be consistent (see electronic supplementary material). In terms of sex differences in specific moral foundations, Care's sex difference effect size was larger in more individualist ($r = 0.30$, 95% CI [0.11, 0.47], FDR-adjusted $p = 0.010$), WEIRD ($r = 0.34$, 95% CI [0.10, 0.57], FDR-adjusted $p = 0.029$), gender-equal (higher gender parity; $r = 0.30$, 95% CI [0.11, 0.47], FDR-adjusted $p = 0.010$), and female-biased (in terms of sex ratio in the population; $r = -0.22$, 95% CI [−0.44, −0.07], FDR-adjusted $p = 0.025$) cultures. Multivariate sex differences (D) in different countries are visualized in figure 1.

3. Study 2

In Study 2, we replicate the findings in Study 1 in an independent dataset, using Bayesian inference. Specifically, we

Table 2. Correlations between sex differences in moral foundations and country-level indicators (Study 1).

variables	cultural variables			socioeconomic variables			gender variables	
	individualism (<i>n</i> = 66)	looseness (<i>n</i> = 48)	WEIRD distance (<i>n</i> = 46)	Gini coefficient (<i>n</i> = 56)	human development (<i>n</i> = 64)	life satisfaction (<i>n</i> = 64)	gender gap (<i>n</i> = 63)	sex ratio (<i>n</i> = 67)
Care <i>d</i>	0.30 ^a	0.16	−0.34 ^a	−0.03	0.12	0.16	0.30 ^a	−0.22 ^a
Fairness <i>d</i>	0.17	0.21	−0.31	−0.06	0.13	0.21	0.19	0.09
Loyalty <i>d</i>	−0.18	−0.14	0.37 ^a	0.12	−0.13	−0.15	−0.02	−0.27
Authority <i>d</i>	−0.21	−0.18	0.24	0.32	−0.23	−0.13	−0.04	−0.22
Purity <i>d</i>	−0.12	0.08	0.13	0.21	−0.10	−0.05	−0.01	−0.24
<i>D</i> _{cu}	0.39 ^a	0.26	−0.30 ^a	0.06	0.15	0.25	0.27 ^a	−0.15

^aFDR-adjusted $p < 0.05$.

conduct secondary analysis on the available data that used a translated and valid version of MFQ in different cultures. The primary research goal was to infer plausible parameter differences in moral foundations across culture. We also aimed to take into account the information from Study 1 to strengthen our inference in Study 2. Hence, we used Bayesian estimation [45], replicating and complementing our frequentist modeling approach in Study 1. Here, we synthesize Study 1's results into our Bayesian MLM in Study 2 to get more precise inferences of country-level effects and cross-country variations in sex differences in moral judgements.

Study 2's dataset included 11 969 participants in 19 countries. The data were provided by individual researchers from these countries, having independently translated the MFQ into local languages and collected data (see electronic supplementary material for implementation procedures in each sample) [46]. We conducted a secondary analysis on data from 11 969 participants in 19 countries: Australia [47] ($n = 1115$), Belgium [48] ($n = 493$), China [49] ($n = 393$), France [50] ($n = 213$), Hungary [51] ($n = 403$), Iran [52] ($n = 501$), Japan [53] ($n = 534$), South Korea [54] ($n = 478$), Latvia [55] ($n = 264$), Mongolia [56] ($n = 444$), the Netherlands [48] ($n = 285$), Poland [57] ($n = 1702$), Russia [56] ($n = 468$), Serbia [58] ($n = 240$), Spain [59] ($n = 240$), Sweden [60,61] ($n = 2068$), Turkey [62] ($n = 1465$), UK [63] ($n = 273$), and USA (Amazon Mechanical Turk) ($n = 390$). The median sample size was 444. Participants in each of the above samples completed locally translated versions of the MFQ-30 and self-reported their biological sex. Participants' gender identity and sexual orientation were not measured. In different sites, different accompanying questionnaires were completed by the participants as well as the MFQ. Country-level indices were retrieved from sources cited in Study 1.

In Bayesian multi-level analyses, the intercept priors were set to a normal distribution based on estimates found in Study 1. More information on procedures and statistical analyses in Study 2 is provided in the electronic supplementary material. In order to ensure the convergence of the Monte Carlo chains, we used 4000 iterations. As suggested by Gelman *et al.* [64], we visually checked the trace plots for all estimates and confirmed convergence in all chains. For the two-level model, the trace plots of the Markov chain Monte Carlo (MCMC) chains exhibited good mixing and showed no convergence problems. Table 3 shows all

parameter estimates from the two-level models for each moral foundation (visualizations available in the electronic supplementary material). With these models, we can more precisely describe how the 'average country' would show sex differences in moral concerns, as well as how countries tend to differ from that average. As can be seen, three female-favouring effects in Care, Fairness, and Purity were successfully replicated.² Across 19 countries, women consistently reported higher scores on Care, Fairness, and Purity. Yet, sex differences in Loyalty and Authority were mixed in direction and smaller in magnitude (as in Study 1, we conducted robustness checks to account for geographical and cultural non-independence of countries; see electronic supplementary materials for details, results were not meaningfully different from the estimates provided in table 3). The multivariate sex difference measure (D_{cu}) was large in size, $M = 0.83$, $Mdn = 0.84$, $s.d. = 0.53$.

Bayesian inferential statistics of the correlations (and their 95% credible interval (CrI)) between country-level cultural, socioeconomic, gender factors, and sex differences in moral foundations are presented in table 4. Global sex differences in moral judgements (D_{cu}) were larger in cultures with higher levels of individualism ($r = 0.59$, 95% CrI [0.14, 0.81], $BF_{10} = 6.26$), cultural looseness ($r = 0.68$, 95% CrI [0.24, 0.86], $BF_{10} = 15.44$), economic equality ($r = -0.55$, 95% CrI [−0.79, −0.10], $BF_{10} = 4.14$), human development ($r = 0.53$, 95% CrI [0.08, 0.77], $BF_{10} = 3.55$), life satisfaction ($r = 0.66$, 95% CrI [0.26, 0.84], $BF_{10} = 23.66$), and gender parity ($r = 0.64$, 95% CrI [0.22, 0.83], $BF_{10} = 15.86$). As a robustness check for the relationship between the size of sex differences and gender inequality [44], we replicated this correlation using the Gender Inequality Index [38] as in Study 1. The results were again shown to be consistent (see electronic supplementary material). The associations between multivariate sex differences in moral judgements and individualism and gender parity fully replicate Study 1's findings.

4. General discussion

Given the pressing need for more conclusive empirical studies of sex differences in moral judgements, we examined women's and men's moral judgements using a high-powered design, and also investigated country-level correlates of sex

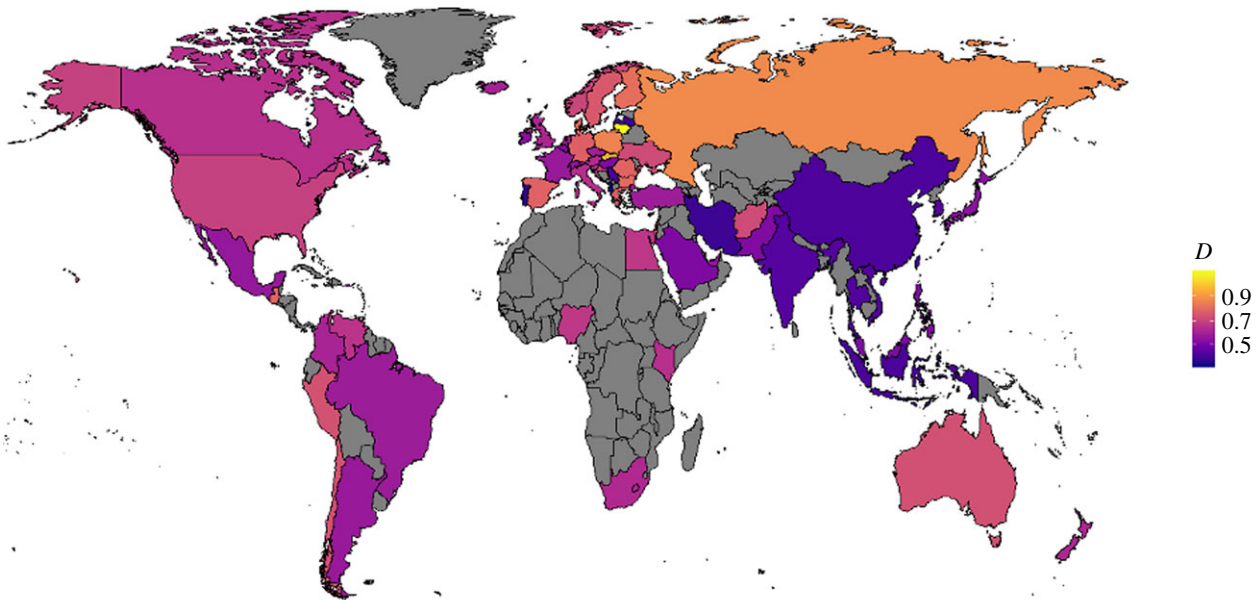


Figure 1. Sex differences in moral judgements across countries. (Online version in colour.)

differences in moral judgements in two consecutive studies. The current research is the first large-scale, cross-cultural investigation to empirically test multivariate sex differences in moral judgements nested within cultures. In Study 1, we examined the role of sex in moral judgements in 67 cultures using a large online sample. Further, in our country-level analysis, we examined the role of country-level cultural, socioeconomic, and gender-related indices in the magnitude of sex differences in moral judgements across cultures. In Study 2, we replicated these findings across 19 countries, by secondary analysis of completely independent data from locally administered, translated versions of the MFQ.

At the broadest level, Study 1 had three major findings: (i) three moral foundations of Care, Fairness, and Purity show systematic sex differences across cultures, with women scoring higher in all three cases, (ii) in more collectivist, non-WEIRD, and male-biased (higher sex ratio) cultures, sex differences in Care become smaller, and (iii) sex differences in Loyalty and Authority are quite variable across cultures. Relying on multivariate sex differences (i.e. Mahalanobis' D and its disattenuated bias-corrected statistic, see [27]) in moral judgements, the present multivariate effect sizes were found to be substantially larger than previously estimated sex differences in moral judgements (e.g. [3,34]) and the median effect size in individual differences research [65]. These multivariate effect sizes of sex differences were substantially larger in individualist and gender-equal countries. Study 2 largely replicated these findings. In particular, (i) women scored reliably higher than men on Care, Fairness, and Purity, (ii) sex differences in Care and Purity were substantially smaller in collectivist and male-biased (higher sex ratio) cultures, and (iii) sex differences in Loyalty and Authority were quite variable across cultures. These replicated findings support the notion that in more egalitarian Western (or Westernized) cultures, women and men tend to diverge in their Care concerns; and that in societies where the number of men for each woman is higher, sex differences in morality (particularly Care) drop substantially [4] which is consistent with the literature on sex ratio and its psychological implications [31]. In these contexts, men are more likely to focus

on family values, long-term relationships, parenting, and caring for offspring since opportunities for short-term mating is scarce.

These culturally variable sex differences in moral foundations have implications for the origin of sex differences in psychology and evolutionary human sciences. First, the magnitude of sex differences, operationalized by multivariate (or global) difference effect size [33], was larger than previously thought, typically relying on univariate effect size, Cohen's d [3,66]. Second, these effects are considerably variable across cultural contexts, thus mono-cultural studies in research on sex differences can be misleading. For example, by looking at sex differences in Loyalty in the USA versus China, one would reach opposite conclusions. Third, these findings can be used to empirically compare (and refine) theoretical perspectives on culturally variable sex differences, hence contributing to a cumulative science of psychology of gender. Women's higher emphasis on Care and Purity judgements may be related to their parental care systems and disgust sensitivity, extensively researched in evolutionary psychology [67,68]. However, our findings regarding sex differences in Loyalty and Authority (i.e. negligible in size and highly variable across cultures) indicate that motivations for ingroup loyalty and hierarchical social structures are not substantially different between women and men across cultures. This finding is in line with evolutionary anthropological research examining sex differences in political leadership in small-scale egalitarian societies indicating that sex differences in leadership and coordination of ingroup members are not directly a product of differences in motivation for status and leadership, but an indirect product of sex differences in cooperation strategies, access to schooling, and sexual division of labour [69]. Furthermore, our results demonstrate that women and men value loyalty to their social networks and respecting authorities almost to the same extent; however, 'social networks' can mean different things for women and men. It is important to women to invest resources in creating and maintaining supportive social networks in order to protect themselves and their offspring [70]. For men, it can sometimes be attractive to invest their resources in forming

Table 3. Results of Bayesian multi-level modelling (Study 2). ESS, effective posterior sample size; \hat{R} , potential scale reduction factor; MCSE, Monte Carlo standard error; CrI, credible interval.

parameter	\hat{R}	ESS	mean	s.d.	MCSE	95% CrI
Care						
intercept	1.01	1499	3.78	0.05	0.001	3.68, 3.89
slope (sex)	1.00	2646	-0.33	0.03	0.001	-0.41, -0.27
error s.d.	1.00	8000	0.73	0.00	0.000	0.72, 0.74
between-country s.d. intercept	1.00	1795	0.09	0.04	0.001	0.05, 0.19
correlation intercept-slope	1.00	2237	-0.02	0.02	0.000	-0.06, 0.00
between-country s.d. slope	1.00	2458	0.02	0.01	0.000	0.01, 0.05
Fairness						
intercept	1.00	1386	3.72	0.05	0.001	3.62, 3.82
slope (sex)	1.00	5838	-0.17	0.02	0.000	-0.20, -0.13
error s.d.	1.00	8000	0.69	0.00	0.000	0.68, 0.70
between-country s.d. intercept	1.00	1501	0.11	0.04	0.001	0.05, 0.21
correlation intercept-slope	1.00	3849	-0.01	0.01	0.000	-0.03, 0.00
between-country s.d. slope	1.00	3114	0.00	0.00	0.000	0.00, 0.01
Loyalty						
intercept	1.00	1945	2.64	0.07	0.002	2.49, 2.77
slope (sex)	1.00	10 267	0.03	0.02	0.000	0.02, 0.08
error s.d.	1.00	16 000	0.82	0.01	0.000	0.81, 0.83
between-country s.d. intercept	1.00	2752	0.14	0.06	0.001	0.07, 0.28
correlation intercept-slope	1.00	9146	-0.01	0.01	0.000	-0.04, 0.01
between-country s.d. slope	1.00	6165	0.01	0.00	0.000	0.00, 0.02
Authority						
intercept	1.00	1420	2.63	0.05	0.001	2.60, 2.72
slope (sex)	1.00	4152	0.02	0.02	0.000	-0.03, 0.07
error s.d.	1.00	8000	0.87	0.01	0.000	0.86, 0.88
between-country s.d. intercept	1.00	1905	0.05	0.02	0.001	0.02, 0.11
correlation intercept-slope	1.00	4165	-0.01	0.01	0.000	-0.03, 0.01
between-country s.d. slope	1.00	2527	0.01	0.01	0.000	0.00, 0.03
Purity						
intercept	1.00	1150	2.35	0.12	0.003	2.10, 2.56
slope (sex)	1.00	6025	-0.17	0.03	0.000	-0.23, -0.10
error s.d.	1.00	8000	0.98	0.01	0.000	0.96, 0.99
between-country s.d. intercept	1.00	1490	0.32	0.13	0.003	0.15, 0.66
correlation intercept-slope	1.00	3355	0.01	0.03	0.000	-0.03, 0.08
between-country s.d. slope	1.00	4682	0.02	0.01	0.000	0.01, 0.06

coalitions to engage in intergroup aggression, as the spoils of an intergroup victory enhance their mating opportunities substantially [71]. Thus, men might be keener than women to take on leadership roles during intergroup competitions. In the case of Loyalty and Authority (which show large cultural variability in sex differences, from men scoring higher than women, to no difference, to women scoring higher than men), cultural evolution can be the key driving force which accounts for the diversity of cultural norms among populations. Cultural evolution is typically 'faster' than biological evolution and can be spread in a population in very few generations. It has been suggested that the legal and political systems that govern societies are themselves outcomes of

cultural evolution [72,73], as it has eventuated over human history.

With regard to cultural variation of sex differences based on cultural, socioeconomic, and gender-related variables, the findings suggested that women and men are more different in their moral judgements in gender-egalitarian societies compared with less egalitarian ones. Notably, however, these results cannot be used to infer any causal relationships between gender equality and the magnitude of sex differences since the data are cross-sectional. Even in countries with gender-equal outcomes (high Gender Gap Index), where women and men have equal access to health and education, entrenched gender norms about moral phenomena

Table 4. Correlations between sex differences in moral foundations and country-level indicators (Study 2). Bayes factors larger than 3 have been bolded.

sex differences	statistic	cultural variables			socioeconomic variables			gender variables	
		individualism (<i>n</i> = 18)	looseness (<i>n</i> = 16)	WEIRD distance (<i>n</i> = 16)	Gini coefficient (<i>n</i> = 18)	human development (<i>n</i> = 19)	life satisfaction (<i>n</i> = 19)	gender gap (<i>n</i> = 19)	sex ratio (<i>n</i> = 19)
Care <i>d</i>	<i>r</i>	0.46	0.07	−0.16	−0.04	0.19	0.30	0.26	−0.36
	BF10	1.67	0.31	0.36	0.29	0.37	0.57	0.49	0.84
Fairness <i>d</i>	<i>r</i>	0.03	−0.24	0.06	0.20	−0.28	−0.13	0.06	−0.60
	BF10	0.29	0.44	0.32	0.39	0.52	0.32	0.29	9.02
Loyalty <i>d</i>	<i>r</i>	−0.24	0.09	0.04	0.13	−0.46	−0.31	0.24	−0.04
	BF10	0.45	0.32	0.31	0.32	1.74	0.61	0.44	0.28
Authority <i>d</i>	<i>r</i>	0.05	0.17	0.00	0.12	−0.11	−0.08	0.24	−0.03
	BF10	0.29	0.36	0.31	0.32	0.31	0.30	0.44	0.28
Purity <i>d</i>	<i>r</i>	0.42	0.39	−0.38	−0.09	0.20	0.19	0.51	−0.48
	BF10	1.15	0.83	0.83	0.31	0.38	0.38	2.89	2.02
<i>D</i> _{cu}	<i>r</i>	0.59	0.68	−0.26	−0.55	0.53	0.66	0.64	−0.16
	BF10	6.26	15.44	0.48	4.14	3.55	23.66	15.86	0.35

persist. Moreover, these findings tell us nothing about individuals' experience of gender inequality and their moral judgements [44]. These findings are consistent with evolutionary psychological research on sex differences across cultures. These results, on the other hand, are in contrast with the original predictions of the social role theory [21]. Notably, social role theory has explicitly incorporated cultural evolutionary components into the theory [20], advocating that 'biological characteristics affect the efficient performance of many activities in society, they underlie central tendencies in the division of labour'. However, this theory's prediction of women and men being more similar in gender-egalitarian societies was not supported here.

Of note, while the present work is not a test of MFT itself, the theoretical limitations of MFT should be noted. MFT's evolutionary roots have been argued to be ad hoc rather than theory-driven. While Graham *et al.* [7] provide an evolutionary function for each of the foundations, the theory itself has been developed without a clear *a priori* evolutionary model. The theory of 'morality-as-cooperation' [74], for example, argues that morality consists of a collection of biological and cultural solutions to the problems of cooperation recurrent in humans' evolutionary history, proposing seven moral domains (family, group, reciprocity, heroism, deference, fairness, and property) which are considered morally good across cultural contexts [74]. Future research is encouraged to replicate and extend the present findings using modern evolutionary theories of morality using corresponding measures [75]. In addition, MFQ has limitations. MFQ measures a pre-specified set of features that are relevant for moral judgement. More specifically, this questionnaire focuses on abstract judgements about what is part of the moral domain, rather than direct moral decision-making. Another limitation of the present studies is their samples. Study 1's sample is a convenience sample from an online platform and Study 2 is a secondary analysis of different samples coming from a relatively heterogeneous set of countries, collected using different procedures.

Hence, future studies are encouraged to replicate these findings using more representative sampling procedures across diverse sets of cultures, including small-scale societies.

5. Conclusion

Are women and men different in their moral judgements? Do sex differences in morality vary across cultures? Previous research on culturally variable sex differences in morality has been relatively sparse, and the few cross-cultural studies that do exist have drawn small samples with inadequate statistical power to capture cross-sex and cross-cultural differences in moral judgements. Our two studies were designed to address many of these shortcomings. We collected individual-level data using the most widely used operationalization of Moral Foundations Theory (i.e. Care, Fairness, Loyalty, Authority, and Purity), and collected country-level data from independent international organizations. We tested hypotheses using both frequentist (Study 1) and Bayesian (Study 2) multi-level models to draw a comprehensive picture of sex differences in five moral foundations in a large number of cultures. Results suggested that women scored higher than men on Care, Fairness, and Purity across cultures. The sex differences in these moral judgements seem to be replicable and robust across cultures. On the other hand, sex differences in Loyalty and Authority were quite variable across cultures. Finally, global sex differences in moral judgements were particularly larger in more individualist and gender-equal cultures.

Data accessibility. The data have been deposited on to the Dryad Digital Repository: <https://doi.org/10.5061/dryad.8w9ghx3jx> [76].

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Endnotes

¹See <http://culturaldistance.muth.io/>.

²We also conducted all these analyses in Study 2 using frequentist multi-level models, as in Study 1, available in the electronic supplementary material for comparison purposes. Notably, the results were convergent.

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