Unearthing the Foundations:

Testing the Universality of Moral Foundations Theory in Three Small-Scale Populations

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Abstract

Moral Foundations Theory proposes five universal moral domains—Care, Fairness, Loyalty, Authority, and Purity—but its empirical support has largely been drawn from affluent, highly educated societies. This limits both the generalisability of the framework and our understanding of the socioecological factors that shape morality. To address this gap, we tested Moral Foundations Theory in three non-industrialised populations: Hadza hunter-gatherers, Datoga pastoralists, and Iraqw agropastoralists. We developed the Moral Foundations Boards, a novel pictorial tool designed to assess sensitivity to violations of the five moral foundations in low-literacy contexts. Participants completed the Moral Foundations Boards, while a sample from the United States served as a comparative reference and completed additional standard measures—the Moral Foundations Questionnaire and the Moral Foundations Vignettes. Although the five-factor structure of Moral Foundations Theory did not consistently emerge, we found cross-cultural variation. Hadza and Datoga participants showed greater sensitivity to Purity-related violations and reduced sensitivity to Care-related violations compared to participants from the United States. These findings challenge claims of structural universality in Moral Foundations Theory and underscore the importance of incorporating diverse socioecological contexts into the study of moral psychology.

Keywords: Moral Foundations Theory, morality, Hadza, Datoga, Iraqw

Millennia ago, Earth was visited by extraterrestrial beings. Before departing, they erected numerous monumental sites across the globe. But instead of complete structures, they left behind five solid stone platforms at each site—identical in shape and form. Over the centuries, human societies discovered these foundations and built atop them using whatever materials were available to them. In some regions, people used dried clay bricks, in others, timber from dense local forests, blocks of limestone, or woven bamboo. Some constructed grand temples on only a few platforms, leaving the rest untouched. Others raised expansive halls that spanned all five. If we could take aerial photographs of all these sites today, we would notice recurring patterns in the structures. While no single photograph could fully uncover the original design, comparing many such sites could help us discern the underlying blueprint of five foundational platforms.

This architectural metaphor was introduced by the researchers behind Moral Foundations Theory (MFT; Graham et al., 2013). They illustrated three central claims of their framework on human morality. First, the human moral mind begins with a "first draft"—a prewired structure shaped by adaptive pressures throughout evolutionary history. Second, because humans have repeatedly faced different types of social challenges, the mind contains multiple distinct moral modules designed to address them. Third, this initial moral template is refined over time through cultural learning. In the metaphor, the aliens represent the evolutionary forces of natural selection, the stone platforms symbolize these innate moral modules, and the diverse structures built upon them reflect culturally

shaped moral systems. While MFT holds that the capacity for all foundations is universal, it also argues that societies vary in which foundations they emphasize. To evaluate these core claims, researchers must collect data across a broad range of cultural settings—much like compiling aerial photographs from multiple sites—to detect shared patterns and understand how different environments shape mental moral modules.

MFT refers to these mental moral modules as foundations and proposes that there are at least five (Haidt & Joseph, 2004; Graham et al., 2013; Graham et al., 2018). These include Care (sensitivity to suffering and nurturance), Fairness (concerns about justice and reciprocity), Loyalty (allegiance to one's group), Authority (respect for hierarchy and tradition), and Purity (avoidance of both physical and moral contamination). Researchers often group Care and Fairness as individualizing foundations, as they focus on protecting individuals and ensuring their well-being. In contrast, Loyalty, Authority, and Purity are known as binding foundations because they promote group cohesion and uphold social order (Strupp-Levitsky et al., 2020; van Leeuwen et al., 2012). While most empirical studies have focused on these five foundations, researchers have proposed potential additions—such as Liberty (Iyer et al., 2012) and Ownership (Atari & Haidt, 2023). Moreover, ongoing debates question whether certain foundations, like Fairness, should be further subdivided into distinct dimensions, such as concerns about equality and proportionality (Atari et al., 2023).

1.1. Cross-Cultural Validation of MFT

To evaluate the central claims of MFT, it is essential to conduct studies across a broad range of human populations. Only then can we assess whether diverse societies share similar underlying moral intuitions, whether observed differences are shaped by cultural, ecological, or institutional factors, and which categories of moral concern truly qualify as foundational. Despite its universalist framing, empirical research on MFT has disproportionately focused on WEIRD populations—those from Western, Educated, Industrialized, Rich, and Democratic societies (Henrich et al., 2010).

WEIRD populations have played a central role in shaping the empirical foundation of MFT. The original study introducing the Moral Foundations Questionnaire—the most widely used tool for measuring MFT—was completed by over 34,000 English-speaking adults registered on YourMorals.org (Graham et al., 2011). Although participants came from various countries, the majority were from the United States, Canada, the United Kingdom, and Australia. This pattern persists in more recent research. For example, a meta-analysis on MFT and political orientation by Kivikangas and colleagues (2021) found that 54% of the samples included in the analysis came from the United States, 19% from Europe, and 11% did not report the origin of their population.

Several studies have sought to address the overrepresentation of WEIRD samples in MFT research by expanding empirical investigations to more culturally diverse populations. In one of the earliest large-scale cross-cultural tests of MFT,

Iurino and Saucier (2020) used the Survey of World Views to collect online data from participants in 27 countries, including non-WEIRD populations such as Ethiopians, Indians, and Filipinos. Their aim was to assess whether the original five-factor structure of MFT could be replicated across a broader range of cultural settings. However, their results did not support the five-factor model, raising concerns about the generalizability of MFT's structure. Doğruyol, Alper, and Yilmaz (2019) analysed data from the Many Labs 2 project, which included participants from 30 countries. Dividing the sample into WEIRD and non-WEIRD groups, they found support for the five-factor structure in both, suggesting a degree of cross-cultural stability. Building on these efforts, Atari and colleagues (2023) conducted studies across 25 countries, intentionally focusing on non-WEIRD countries. They developed a revised version of the Moral Foundations Questionnaire-2 to enhance measurement validity in cross-cultural contexts. Their findings indicated that individuals from less-WEIRD societies tend to show heightened sensitivity to violations of Purity and Loyalty, leading the authors to emphasise the importance of studying small-scale societies to better capture the global diversity of moral foundations.

Even when MFT studies extend beyond Western contexts, they often rely on online samples—participants with internet access, sufficient literacy, and the time and resources to engage in survey research. This applies even to the cross-cultural studies described above. Although such individuals may reside outside of WEIRD countries, their lifestyles and cognitive environments often closely resemble those of typical WEIRD populations. As a result, these studies may not fully capture the moral intuitions of individuals living in more traditional or small-scale societies. Researchers studying MFT have acknowledged this limitation, highlighting the need for research in culturally diverse and underrepresented populations—particularly those whose social ecologies differ substantially from industrialised, democratic contexts (Atari et al., 2023; Graham et al., 2018).

1.2. Morality Among Small-Scale Societies

To our knowledge, no published studies have yet applied MFT in the context of small-scale, non-industrialised societies. However, several investigations have explored how morality functions in such settings using alternative frameworks or operationalizations of morality. Most of this work has drawn on three main approaches: cooperation-based models, the deontological–utilitarian distinction, and folk or intuition-based perspectives. The cooperative framework, in particular, has been extensively developed by anthropologists and evolutionary social scientists. In the following section, we highlight a selection of recent empirical studies that offer insight into moral reasoning in small-scale societies and inform the broader cross-cultural science of morality.

Economic games have become a key tool for examining moral behaviour in small-scale societies, particularly within a cooperation-based framework. However, this line of research has primarily focused on these societies in isolation, limiting direct comparisons with WEIRD populations. For example, Purzycki and colleagues (2018) linked

locally salient moral concepts—such as honesty and dishonesty—to behaviour in experimental games across eight field sites, finding that participants from small-scale societies were slightly more honest when their moral models emphasised task-relevant virtues. Conte (2022) showed that Mongolian herders were more generous in allocation games toward reputable and closely related partners, underscoring the role of future cooperation and kinship ties. Among the Hadza, Smith and colleagues (2022) found that exposure to other cultures influenced partner choice: those with greater exposure preferred to share with generous individuals, suggesting that cooperative preferences shift with higher exposure to different cultures. Singh and Garfield (2022) analysed 444 transgressions among Mentawai horticulturalists and found that moral responses—such as demands for compensation or third-party mediation—aimed primarily to restore dyadic cooperation rather than enforce group norms. Together, these studies suggest that in small-scale societies, moral decisions are shaped by the logic of cooperation.

Moral judgments may also refer to tension between deontological and consequentialist, specifically utilitarian, inclinations—that is, between adhering to moral rules such as "do not kill" and promoting outcomes that maximize overall well-being, such as "do whatever results in the greatest good for the greatest number." For instance, deontologists would not agree to kill one person to save five, but utilitarians would agree to kill one person to save five. Results on such moral judgments among small-scale societies are mixed. On the one hand, Sorokowski and colleagues (2020) showed that Yali horticulturalists in Papua were less utilitarian (so more deontological) than participants from WEIRD societies; they were less willing to endorse causing harm to one person to save five others. On the other hand, members of the Mayangna/Miskito communities in Nicaragua tended to favour utilitarian choices more than WEIRD populations when presented with similar sacrificial dilemmas (Winking & Koster, 2021). Meanwhile, research by Smith and Apicella (2022) with the Hadza hunter-gatherers of Tanzania revealed no consistent preference for either utilitarian or deontological responses. Extending this line of research, Turpin and colleagues (2021) studied moral preferences among the Dani of Papua and participants from the United States, showing that people in both groups favoured agents who behaved predictably—regardless of whether their actions followed moral rules (deontological approach) or produced better outcomes (utilitarian approach). This finding highlights a cross-cultural preference for social predictability, suggesting that preferences for deontological or utilitarian solutions in moral dilemmas are context dependant.

Several studies have investigated morality in small-scale societies using intuitive or culturally specific approaches rather than formalised moral frameworks. Among the Hadza, for example, moral character is often equated with having a "good heart"—a culturally salient concept associated with being a good person. While there is general agreement about which traits define good character, people often disagree on who in their camp actually possesses these traits (Smith & Apicella, 2020). In a cross-cultural study spanning seven societies, including the Dani of Papua and the Burusho of

Pakistan, Sorokowski and colleagues (2023) found that older individuals were consistently perceived as more moral than younger ones. Moral judgment in this case was assessed through two straightforward questions—one about who follows moral rules and another about who best understands them—reflecting intuitive folk theories of moral competence. Misiak and colleagues (2023) examined moral judgments about food wasting among the Hadza and Datoga. Since these groups do not use a specific term for "morality", the researchers employed a pictorial ranking task featuring behaviours identified as "bad". They found that individuals with poorer nutritional status judged food-wasting behaviour as worse. Finally, Zefferman and Mathew (2020) studied Turkana pastoralist warriors in Kenya to explore the concept of moral injury in the context of warfare. Moral violations were defined through local beliefs about appropriate wartime conduct, and researchers linked self-reported violations of these beliefs to mental health outcomes—without relying on any scientific framework of morality.

Despite increasing interest in the cross-cultural study of morality, MFT has not yet been applied in research with small-scale societies. One likely reason is the lack of appropriate methodological tools. Research in small-scale, often non-literate populations has relied on approaches that do not require reading or abstract verbal reasoning. For instance, participants have taken part in economic games to reveal moral preferences (e.g., Purzycki et al., 2018), made binary moral decisions in simplified scenarios, or used visual scales and pictorial stimuli to express their moral judgments (e.g., Misiak et al., 2023; Turpin et al., 2021). In contrast, MFT has traditionally been studied using lengthy text-based instruments, such as the Moral Foundations Questionnaire, which requires respondents to rate statements using Likert-type scales. These tools are impractical—if not entirely unusable—in small-scale societies where literacy is low and abstract survey formats may not be culturally meaningful. Testing MFT in these contexts requires methodological innovation.

1.3. The Current Research

According to MFT, five distinct moral foundations are universal features of the human moral mind. However, because nearly all existing studies rely on participants from literate, industrialised, and market-integrated societies, the universality of this structure remains untested in small-scale populations that more closely reflect ancestral human environments (Hawkes et al., 2018). Given MFT's claims of universality, we hypothesised that the five-factor structure would replicate in small-scale populations. Our sample included Hadza hunter-gatherers, Datoga pastoralists, and Iraqw agropastoralists in Tanzania. These groups were compared both with one another and with a reference sample from the United States, which has served as a cornerstone in MFT research. We also explored how moral concerns are prioritised across groups, though we did not formulate specific predictions about differences in the relative importance of particular moral foundations. This part of the study was exploratory.

To address the practical challenges of conducting research in non-literate populations, we

developed a novel pictorial task designed to measure moral judgments without relying on written language or abstract Likert-type scales—the Moral Foundations Boards. This hands-on, best–worst scaling method allows participants to indicate which of several depicted behaviours they consider the worst and the least bad (Louviere et al., 2015), offering a simple and culturally appropriate way to assess moral sensitivity. By using the same pictorial task across all groups, we can make cross-cultural comparisons while avoiding the limitations of standard survey-based instruments.

Confirming the MFT structure in small-scale societies would provide strong support for its central claim that the moral foundations reflect a shared, evolved psychological architecture, while variation in their salience could offer insight into how cultural and ecological factors shape morality.

1.3.1. *Ethnographic Background*

This study was conducted among three culturally and ecologically distinct populations in northern Tanzania: the Hadza, Datoga, and Iraqw. All three groups inhabit the northern Tanzanian Rift Valley, a region marked by ecological diversity—including savannahs, woodlands, and volcanic highlands—centred around Lake Eyasi and the Manyara Region. These populations differ markedly in their subsistence strategies, social organisation, and levels of integration with formal institutions and market economies, providing a valuable context for examining cultural variation in morality.

The Hadza are a hunter-gatherer population (Blurton-Jones, 2016; Marlowe, 2010) who maintain a highly mobile lifestyle, moving frequently in response to seasonal changes in resource availability. Unlike neighbouring groups, the Hadza do not engage in agriculture or animal husbandry and have minimal integration into market economies, relying almost entirely on wild resources for subsistence. Hadza society is notably egalitarian, with no formal leadership or rigid hierarchies. Decisions are typically made through consensus, and influence is earned informally—often by elders and skilled hunters whose opinions carry weight due to their experience. Social roles are distributed by age, gender, and expertise. Men generally focus on hunting larger game, such as antelopes and baboons, using bows and arrows, while women specialise in gathering fruits, roots, and other edible plants. The Hadza exhibit a range of spiritual beliefs, with some individuals adhering to traditional cosmologies involving ancestral spirits or other supernatural agents. Although religious practices are not centrally organised, ritual activities—such as initiation rites, dances, and food taboos—continue to play a role in community life (Marlowe, 2010).

The Datoga are a semi-nomadic population (Butovskaya, 2012; Muller et al., 2009), traditionally organised as a pastoralist society centred on cattle herding. Social organisation places significant authority in the hands of elders, who play a central role in community decision-making. Men are primarily responsible for herding and defence and often hold leadership positions, particularly in older age. Women are responsible for household tasks and childcare and often contribute to water collection and craft production. The Datoga are also known for their artisanal skills, particularly in metalworking, producing tools, weapons, and jewellery through

techniques passed down across generations. Ceremonial events—such as weddings, coming-of-age rituals, and ancestor veneration—are vital expressions of community identity and cohesion. The Datoga traditionally practise a form of animism, with spiritual beliefs centred on the presence of ancestral and nature-based spirits. Religious rituals often involve sacrifices intended to appease these spirits and secure blessings for various life endeavours.

The Iraqw are small-scale agropastoralists (Baker & Wallevik, 2008; Snyder, 2018). Agriculture is the primary livelihood of the Iraqw, and they are known for their skill in crop cultivation, including the construction of terraced fields adapted to the region's hilly terrain. Iraqw society is organised into patrilineal clans, with descent and inheritance traced through the male line. Clan membership plays a central role in shaping individual identity and maintaining social cohesion. Traditional leaders—often elders or respected members of the clans—are responsible for decision-making and conflict resolution within the community. Gender roles are clearly defined but complementary: women traditionally oversee domestic and caregiving duties, while men are primarily engaged in agriculture, housing, economic matters, and community leadership. The Iraqw maintain rich cultural traditions, including music, dance, storytelling, and ritual practices. Most Iraqw today are Christian—mainly Catholic or Lutheran—while traditional animism and ancestor worship persist marginally in remote areas, mostly among the elderly.

2. Methods

2.1. Transparency and Openness

We report all measures and data collection procedures in line with JARS guidelines (Appelbaum et al., 2018). The final sample size was not determined in advance due to recruitment constraints. Further details are provided below, along with a sensitivity power analysis to assess statistical power. No data were excluded from the analyses. The study was not preregistered. All data and the analysis output have been made publicly available at the Open Science Framework.[1] All study materials are included in the Supplement. Data were analysed using Jamovi (version 2.4.11; The Jamovi Project, 2023) and RStudio (version 4.4.1; Posit Team, 2025), with the *lme4* (Bates et al., 2014) and *simr* (Green & MacLeod, 2016) packages.

2.2. Participants

We recruited participants from three non-industrialized Tanzanian populations—Datoga, Hadza, and Iraqw—as well as a control sample from the United States. The total sample included N = 170 participants from the Tanzanian populations and N = 300 from the United States. Descriptive statistics for each group are presented in Table 1. The study was conducted in August 2018.

[1] https://osf.io/xm3j6/?view_only=b28ddb16c0ac45e0b3fdfcb1a3bc0f34

Table 1

Descriptive Statistics for Sample Composition

		Gender		Age	
Sample	*n*	Women (%)	Men (%)	*M*	*SD*
Datoga	70	40 (57%)	30 (43%)	35.81	14.32
Hadza	70	31 (44%)	39 (56%)	33.90	13.90
Iraqw	30	10 (33%)	20 (66%)	24.93	7.21
USA	300	173 (57%)	121 (40%)	41.30	14.82

Note. Three participants from the United States identified as non-binary, and another three chose not to disclose their gender.

For the Tanzanian samples, we collected data on age and gender only. The comparison sample from the United States additionally provided information on political affiliation (38% Democrats, 30% Independents, 23% Republicans, 9% other) and religious identity (20% Roman Catholic, 19% Protestant, 14% Atheist/Agnostic, 3% Muslim, 2% Jewish, 1% Mormon, 40% other).

The final sample size was determined by practical constraints, including the limited timeframe of our field expedition and the challenges of accessing participants in remote regions. As a result, we did not conduct an a priori power analysis and instead recruited as many participants as was feasible under these conditions. To evaluate whether the obtained sample provided sufficient statistical power, we conducted a Monte Carlo sensitivity analysis based on our actual model structure. In this analysis, we simulated a realistic interaction between Moral Foundation and Population, corresponding to an expected difference of approximately 20% in moral sensitivity scores across foundations and cultural groups. Across 1,000 simulated datasets, the model demonstrated 92.1% power (95% CI: 90.3%–93.7%) to detect such an interaction. These results indicate that, despite fieldwork constraints, the study was well-powered to identify moderate cross-cultural differences in moral sensitivity (analysis code provided in the Supplement, Appendix 1).

The study complied with the Declaration of Helsinki on Biomedical Research Involving Human Subjects, and the data collection protocol was approved by the Commission for Science and Technology of Tanzania (COSTECH) and by the Ethics Committee of the Institute of Psychology, University of Wroclaw.

2.3. Procedure

For the Hadza and Datoga populations, upon arrival at each camp or boma, we first contacted the local group leader and extended an invitation to participate in the study. After we set up our research station, adult individuals interested in

participating approached us voluntarily and were assessed individually. Iraqw participants were approached directly in the town of Karatu. In all Tanzanian locations, the procedure was conducted in Ki-Swahili by a local research assistant fluent also in Hadzane, and English. Participants were informed that their participation was voluntary and that they could withdraw at any time. Due to widespread illiteracy, oral consent was obtained. Participants then completed the Moral Foundations Boards and answered a question about their age.

The comparison sample from the United States was recruited through the Syno International online paid panel. To provide a meaningful point of comparison for the Moral Foundations Boards, participants also completed the Moral Foundations Questionnaire (Graham et al., 2011) and the Moral Foundations Vignettes (Clifford et al., 2015). In addition, they provided demographic information including age, gender, political affiliation, and religious identity.

2.4. Measures

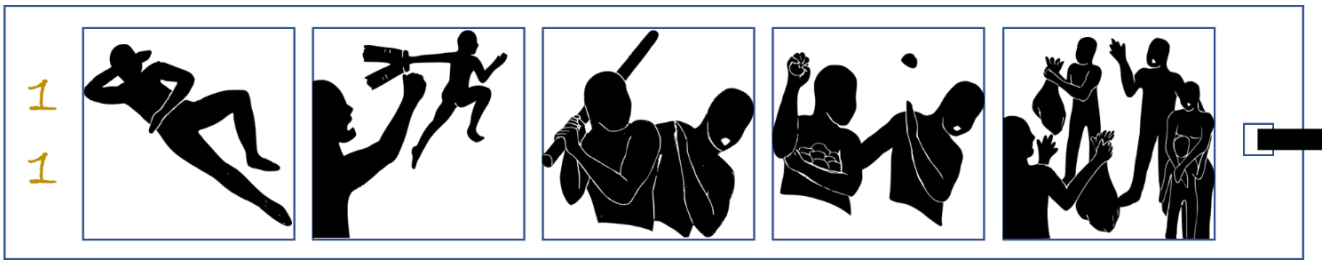
2.4.1. Moral Foundations Boards

Drawing on our prior experience designing instruments for use with illiterate populations (Misiak et al., 2018, 2024), we developed the Moral Foundations Boards—a pictorial, hands-on measurement tool based on the best-worst scaling method (Louviere et al., 2015). This format allowed participants to evaluate the relative severity of various immoral behaviours and express their moral judgments non-verbally, facilitating the assessment of sensitivity to moral violations across different foundations.

Moral Foundations Boards were specifically created to depart from conventional text-based survey methods typically used in the study of MFT. Each participant received a set of 12 boards, with each board displaying five pictorial items, each representing a different moral violation (see Figure 1). The boards were made from white plastic (approximately 100 cm × 20 cm), and each image was printed on standard paper and affixed to the board's surface (see Figure 2). The full set of boards was held together using a cable tie, allowing easy handling and sequential presentation. Each board was labelled with two identifiers: the set number (1–10) and the board number (1–12), ensuring the correct order during administration. The illustrations were designed by a visual artist following clear guidelines: all characters were to appear as neutral as possible, avoiding culturally specific elements such as clothing, age markers, or gender cues—unless such features were essential to the interpretation of the moral violation. A comprehensive overview of all pictorial items is available in the Supplement (Appendix 2).

Figure 1

Exemplary Board From the Moral Foundations Boards



Note. The behaviours depicted on this board are: (1) Lying to avoid work, (2) Stealing someone's clothes, (3) Hitting a person with a stick for no reason, (4) Throwing a stone at another person, (5) Trading with the enemy of your family.

Figure 2

A Photograph of the Moral Foundations Boards that Presents all 10 Sets

Note. The boards are worn out, as the picture was taken at the end of the expedition after completing the field study. Taken by Michal Misiak.

We developed a set of 20 pictorial items, each illustrating a distinct moral violation. These items were evenly distributed across the five moral foundations, with four items assigned to each foundation (see Table 2). During the task, participants were shown one board at a time and asked to indicate which behaviour they considered to be "the worst" and which was "the least bad" among the five behaviours displayed.

Each participant completed a full set of 12 boards. On each board, five behaviours were presented in pseudo-randomized combinations to enable meaningful com-parisons across items. The exact item order is presented in Table S1 in the Supplement. Each behaviour appeared three times across the full set, each time in a different configuration, allowing participants to make multiple within-subject comparisons. The entire Moral Foundations Boards procedure took approximately 6 to 8 minutes per participant.

Table 2

List of Items (Moral Violations) From the Moral Foundation Boards

No.	Behaviour	Moral Foundation
1.	Biting someone so that they bleed	Care
2.	Hitting your child	
3.	Hitting another person with a stick for no reason	
4.	Throwing a stone at another person	
5.	Telling lies to someone	Fairness
6.	Stealing someone's clothes	
7.	Lying to avoid work	
8.	Eating food that belongs to someone else	
9.	Speaking bad things about your own group	Loyalty
10.	Speaking bad things about your own family	
11.	Trading with the enemy of your family	
12.	Helping your friend's enemy	
13.	Insulting your father and mother	Authority
14.	Ignoring father's commands	
15.	Being a man and performing women's duties	
16.	Quarrelling with an older person	
17.	Having sex with a stranger	Purity
18.	Having frequent sexual intercourse with different people	
19.	Having sex with a grandfather or grandmother	
20.	Marrying your own daughter	

For participants in the United States, the boards followed the same design, using identical images and the same pseudo-randomization method. However, the task was digitized and administered online via the Qualtrics platform.

Item Generation. We compiled a list of 20 moral violations intended to be universally perceived as immoral or "bad." To ensure the cross-cultural relevance of these behaviours, the list was validated by one of the authors [blinded for peer review], an anthropologist with extensive experience working with the studied populations. During this process, several behaviours from the initial item pool—particularly within the Purity domain—were excluded based on the concerns that they could provoke excessively negative emotional reactions or undermine participants' trust. Additional validation was provided by our Tanzanian research assistants, who helped assess the clarity and cultural appropriateness of each scenario. The final set of items was generated in alignment with the theoretical foundations of MFT and was closely modelled on stimuli from established instruments used in previous research (Clifford et al., 2015; Graham et al., 2011).

Procedure Overview. At the beginning of the task, participants were informed that they would be presented with sets of behaviours and asked to identify both the worst and the least bad behaviour from each list. They were also instructed that all scenarios involved members of their own group—no out-group individuals were included. In the item "Speaking bad things about your own group," the phrase "your own group" was replaced with the specific name of the participant's group.

Participants were then shown the first board, which displayed five pictorial items representing different moral violations. These images were included solely to assist participants in making their selections. For each board, the assistant verbally described the depicted behaviours, providing brief contextual details for each moral violation. Participants were first instructed to point to the behaviour they considered "the worst" according to their personal judgment, and then to indicate the behaviour they found "the least bad." The phrase "bad behaviours" was intentionally used to accommodate potential semantic differences in how morality and immorality are conceptualized in Hadza, Datoga, and Iraqw languages, compared to Indo-European languages.

Scoring. For each behaviour identified as the "worst," we assigned a score of -1, while the behaviour judged as "least bad" received a score of +1. The remaining three items on each board were assigned a score of 0. Each participant completed 12 boards, and every behaviour appeared three times across the set in different combinations. Thus, any given behaviour could be selected as the worst or least bad up to three times, resulting in a possible score range of -3 (consistently worst) to +3 (consistently least bad). To minimize potential order effects, we created 10 versions of the task with pseudo-randomized item arrangements. Each participant received one version, consisting of 12 boards, each containing 5 items.

2.4.2. Moral Foundations Questionnaire

We used the Moral Foundations Questionnaire (Graham et al., 2011) to assess the extent to which participants endorsed five moral foundations among the comparison sample from the United States. The questionnaire includes 30 items divided into two subscales: a relevance subscale, which measures how important each foundation is

to the respondent, and a judgment subscale, which assesses agreement with various moral statements. Example items include statements such as "It can never be right to kill a human being" for Care, "When the government makes laws, the number one principle should be ensuring that everyone is treated fairly" for Fairness, "People should be loyal to their family members, even when they have done something wrong" for Loyalty, "Men and women each have different roles to play in society" for Authority, and "People should not do things that are disgusting, even if no one is harmed" for Purity. Participants rated each item on a five-point scale ranging from 1 (not at all relevant or strongly disagree) to 5 (*extremely relevant or strongly agree*). The scale showed good internal consistency, with Cronbach's alpha values of .78 for Care, .76 for Fairness, .73 for Loyalty, .71 for Authority, and .80 for Purity.

2.4.3. *Moral Foundations Vignettes*

The Moral Foundations Vignettes (Clifford et al., 2015) were used to measure sensitivity to violations of moral foundations among the United States sample. This instrument presents respondents with short scenarios in which individuals engage in morally questionable behaviours and asks them to evaluate whether these actions are morally wrong, and if yes, to what degree.

We used a set of 15 vignettes, with three scenarios representing each moral foundation, apart from the additional foundation of liberty, as we focused on the classical set of five. Example vignettes include a woman spanking her child with a spatula for receiving bad grades in school (Care), someone cheating in a card game while playing with strangers (Fairness), a class president stating on television that a rival college is better (Loyalty), a man turning his back and walking away while being questioned by his boss (Authority), and a man searching through the trash for women's discarded underwear (Purity). Participants rated each scenario on a five-point scale ranging from 1 (*not at all wrong*) to 5 (*extremely wrong*). The vignettes were presented in randomized order. The measure demonstrated acceptable internal consistency across foundations, with Cronbach's alpha values of .68 for Care, .78 for Fairness, .79 for Loyalty, .66 for Authority, and .69 for Purity.

2.4.4. Sociodemographic Questions

All participants were asked to report their age. In the Tanzanian groups, gender was assessed by the research team based on participants' appearance and clothing. In societies with strict gender roles, directly asking about gender could be perceived as inappropriate or offensive. To account for sample diversity, participants from the United States were additionally asked about their political affiliation, religious affiliation, education level, degree of religiosity, and their views on social and economic conservatism, measured using the Social and Economic Conservatism Scale (SECS; Everett, 2013).

2.5. Statistical Analyses

2.5.1. Step I – Top-Down Approach

In the first step of our analysis, we examined data from the Moral Foundations Boards task using a theory-driven approach. This step was grounded in the conceptual framework of MFT, meaning we applied the original categorisation of behaviours into five domains as outlined by Graham et al. (2013). Our primary aim here was not to test the psychometric properties of the new tool, but rather to assess whether moral sensitivity to these theoretically defined domains varies across cultures.

This approach prioritised content validity: the Moral Foundations Boards included diverse behaviours intended to represent each foundation, and our interest was in how participants from different populations weighted these categories of moral concern. Although the internal coherence of the five foundations was examined separately in our bottom-up analyses, the top-down step was necessary to stay aligned with MFT's theoretical structure and to make the results comparable with prior studies using this framework. In this sense, the top-down analysis served as a test of theoretical applicability, not of measurement validity.

Given that moral ratings were treated as frequency variables (scores were based on how often items were selected as either the worst or the least bad), we employed a Generalized Linear Mixed Model (GLMM) with a Poisson distribution to account for the count-based nature of the data. We restructured the dataset into long format to facilitate analysis. The model included Moral Foundation (within-subject factor), Population (between-subject factor), and their interaction as fixed effects. Participant ID was included as a random intercept, allowing us to account for individual-level variability in baseline moral sensitivity. This approach enabled us to model the frequency with which participants scored behaviours within each moral foundation category.

Due to the design of the Moral Foundations Boards, each participant—and by extension, each population—was required to assign an equal number of positive and negative scores. In this forced-choice task, participants selected 12 behaviours as the most severe (scored +1) and 12 as the least severe (scored –1). As a result, comparisons of overall moral sensitivity across populations were not meaningful, since the mean score was fixed and identical across groups by design. However, it was still possible to analyse differences in sensitivity to specific behaviours or moral foundations, as participants determined for themselves which behaviours to score most and least severely. The inclusion of the Population variable in the model was specifically intended to test for its interaction with Moral Foundation. The non-significant main effect of Population was expected and fully consistent with the structure of the task.

Model estimates, confidence intervals, and significance tests were obtained using maximum likelihood estimation. For clarity of interpretation, the moral scores were reversed such that higher values indicate greater sensitivity to violations of a given moral foundation.

2.5.2. Step II – Bottom-Up Approach

In the second step of our analysis, we conducted bottom-up analyses, beginning with confirmatory factor analyses (CFA) for each measure: Moral Foundations Boards, Moral Foundations Questionnaire and Moral Foundations Vignettes. To evaluate the suitability of these models for further analysis, we assessed standard model fit indices, including the Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA). Moral foundations frequently fail to meet psychometric standards, which has led researchers to test alternative structures—most notably, a two-factor model in which Care and Fairness form an Individualizing dimension, while Loyalty, Authority, and Purity are grouped into a Binding dimension (for example, Nejat et al., 2023). We therefore tested this two-factor model as well.

Since neither the five-factor nor two-factor solution was supported, we shifted our focus to examining differences in judgments of individual behaviours. To achieve this, we conducted two Generalized Mixed Models (GMMs). In the first model, Participants and Population were included as cluster variables (random intercepts), with moral behaviour as a fixed effect. In the second model, Participants were treated as a cluster variable, while Population and the interaction between Population and moral behaviour was included as a fixed effect. This approach allowed us to analyse the effect of each behaviour across the entire sample in the first model and the effect of each behaviour within each population in the second model. The moral rating of a given behaviour was treated as a frequency variable, and we specified a Poisson distribution for the model.

3. Results

3.1. Step I – Top-Down Approach

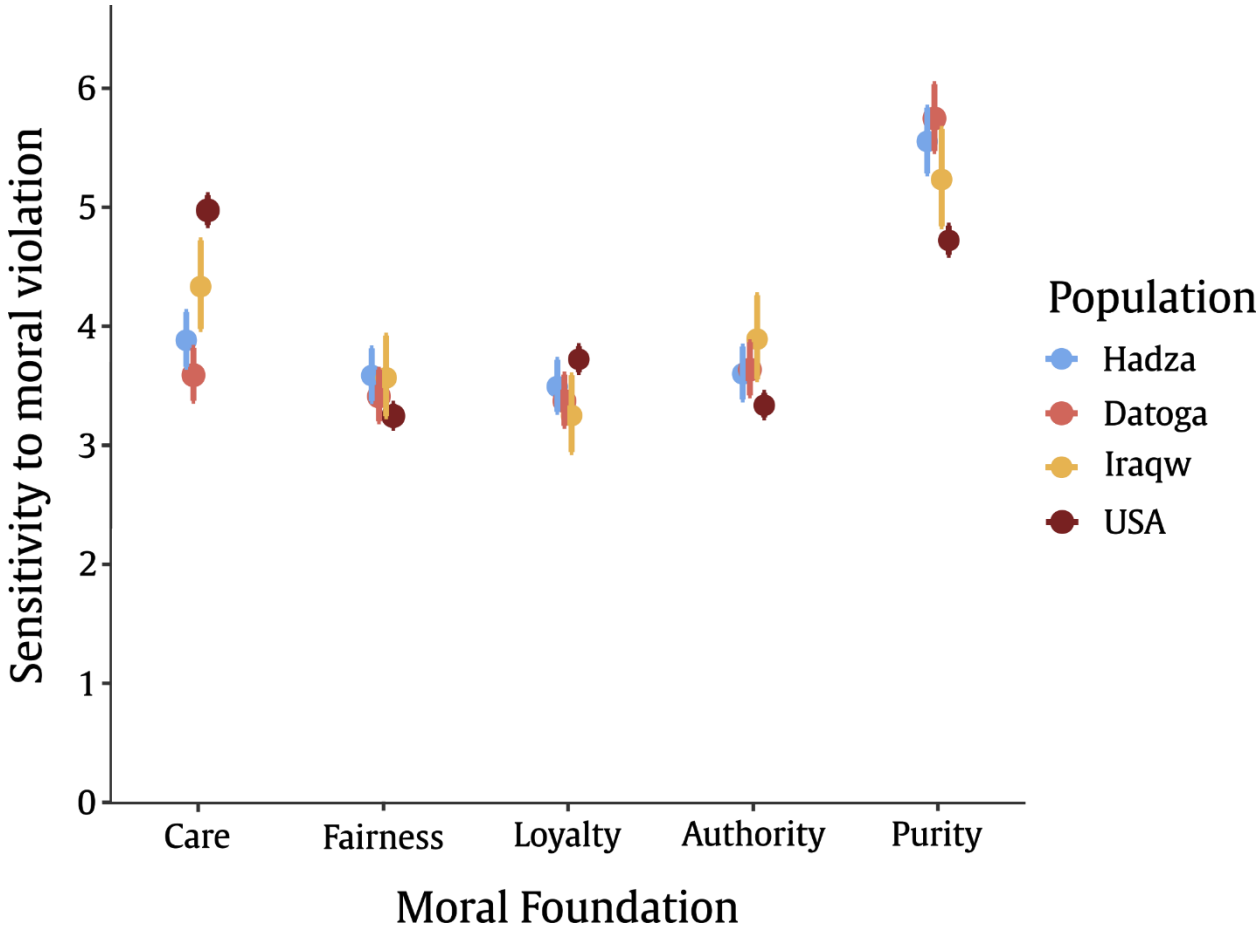
The results of the GLMM analysis indicated a significant main effect of Moral Foundations on moral sensitivity, $X^2(4) = 604.68$, $p < .001$, suggesting that participants judged behaviours differently depending on the moral domain. No significant main effect of Population was found, $X^2(3) = 2.54$, $p = .467$, indicating no overall differences in average moral sensitivity between groups (this was expected given the structure of the Moral Foundations Boards). However, there was a significant interaction between Moral Foundations and Population, $X^2(12) = 238.84$, $p < .001$, suggesting that the pattern of moral sensitivity varied across groups. On average, participants rated Purity violations as the most morally wrong, while Fairness and Loyalty violations were judged as the least wrong.

The results indicate group differences in sensitivity to moral violations in the domains of Care and Purity. For Care, both the Hadza and the Datoga were significantly less sensitive than participants from the United States (USA – Hadza: $\exp(B) = 1.28$, $p < .001$; USA – Datoga: $\exp(B) =$

1.39, p < .001), while the Iraqw did not differ significantly from any other group. In the domain of Purity, the pattern was reversed: both the Hadza and the Datoga were significantly more sensitive than participants from the United States (USA – Hadza: exp(B) = 0.85, p < .001; USA – Datoga: exp(B) = 0.82, p < .001), with no significant differences involving the Iraqw. For Fairness, Loyalty, and Authority, no significant group-level differences were observed. The results, including post-hoc tests, are presented in the Supplementary Materials (Tables S2–S4) and visualised in Figure 1.

Figure 1

Estimated Moral Sensitivity Scores Across Moral Foundations by Population



Note. The figure displays predicted values (value-reversed scores) from the Poisson Generalized Linear Mixed Model (GLMM), including 95% confidence intervals. Higher scores reflect greater sensitivity to moral violations. Moral Foundations: Care, Fairness, Loyalty, Authority, and Purity.

3.2. Step II – Bottom-Up Approach

CFAs did not support the five-factor structure for either the Moral Foundations Boards or Moral Foundations Questionnaire. In the United States sample specifically, the five-factor model for the Moral Foundations Boards did not converge. However, the five-factor structure was supported for the Moral Foundations Vignettes. The two-factor solution—distinguishing between individualizing and binding foundations—was not supported for any of the three instruments. Full model fit indices are presented in Table 3. The correlation matrix between various MFT measures for the USA sample is provided in the Supplement (Table S5).

Table 3

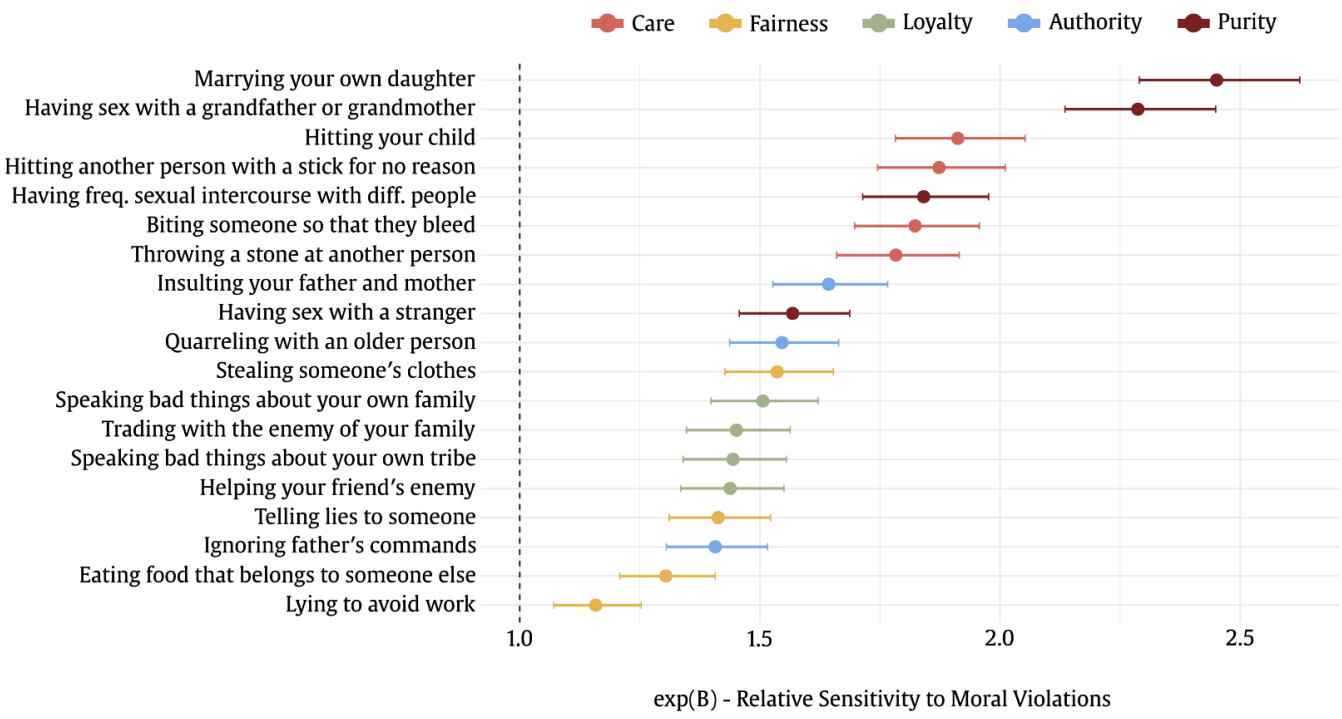
Fit Indices for Models Testing the Structure of the Moral Foundations Theory

Structure	Model	Sample	CFI	SRMR	RMSEA
Five-factor	Moral Foundations Boards	Full	.796	.093	.077
	Moral Foundations Boards	USA	NA	NA	NA
	Moral Foundations Questionnaire	USA	.726	.097	.098
	Moral Foundations Vignettes	USA	.934	.048	.064
Two-factor	Moral Foundations Boards	Full	.316	.078	.137
	Moral Foundations Boards	USA	.031	.097	.334
	Moral Foundations Questionnaire	USA	.713	.098	.099
	Moral Foundations Vignettes	USA	.753	.089	.118

To explore differences in how individual behaviours were judged across the entire sample, we fitted a Poisson Generalized Linear Mixed Model. The model significantly predicted moral sensitivity scores, $\chi^2(19) = 1621.64$, $p < .001$, with a marginal R^2 of 0.16 (AIC = 33,795.30, BIC = 33,945.42). Among the 20 behaviours, violations related to Purity (e.g., "Marrying your own daughter", "Having sex with a grandfather or grandmother") and Care (e.g., "Hitting your child", "Hitting another person with a stick for no reason") received the highest scores, whereas items such as "Being a man and performing women's duties" and "Lying to avoid work" were rated least morally wrong. Full parameter estimates are provided in Supplementary Table S6, and a visualization of key differences is presented in Figure 2.

Figure 2

Estimated Sensitivity to Moral Violations (exp(B)) by Behaviour with 95% Confidence Intervals

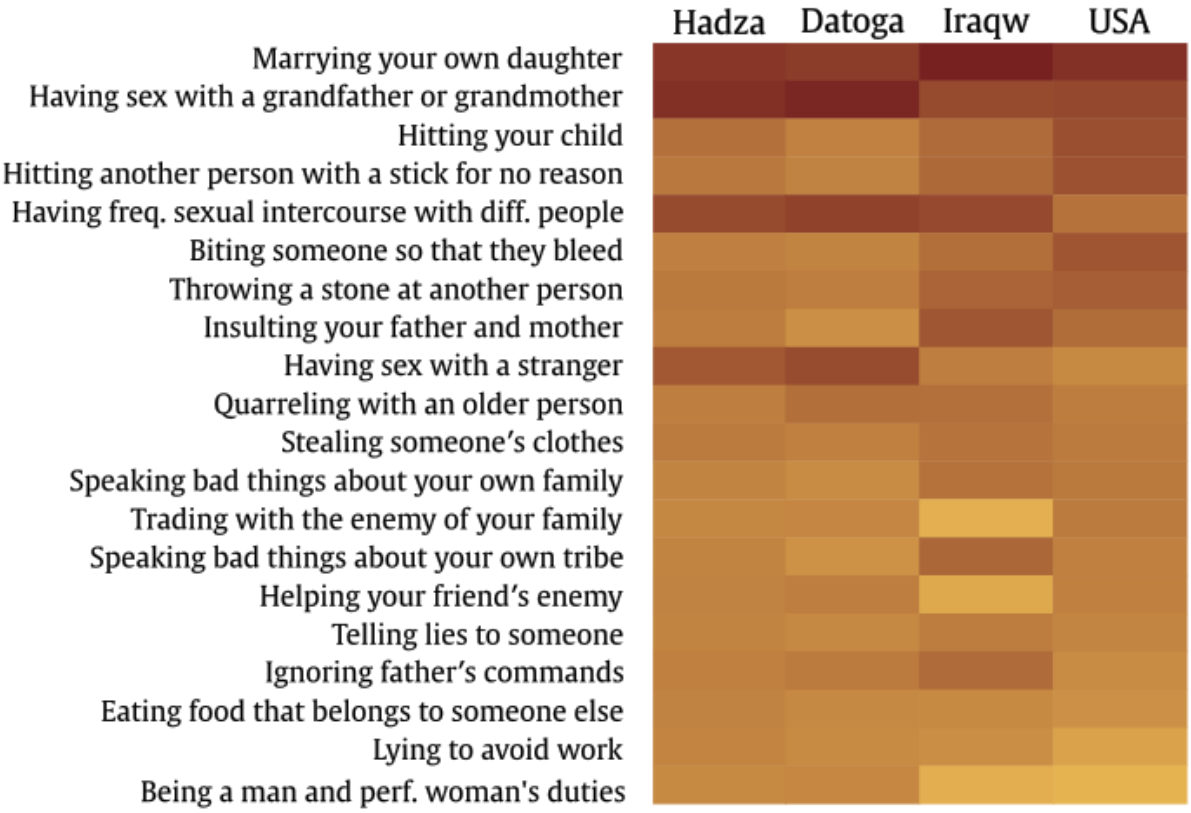


Note. "Being a man and performing women's duties" was treated as the reference point, as it was judged the least morally wrong. Values represent estimated moral sensitivity aggregated across all studied populations (Hadza, Datoga, Iraqw, and USA). Colours reflect the moral foundation category of each behaviour for illustrative purposes only; moral foundations were not included as predictors in the model.

To assess whether the perceived immorality of specific behaviours varied across cultural groups, we fitted a Poisson Generalized Linear Mixed Model. The model showed a significant main effect of Behaviour, $\chi^2(19) = 832.26$, $p < .001$, and a significant Behaviour × Population interaction, $\chi^2(57) = 474.27$, $p < .001$, indicating that moral sensitivity to particular violations differed by group. The model demonstrated a marginal R^2 of 0.203 (AIC = 33,450.19, BIC = 34,029.21). Full parameter estimates are reported in Supplementary Table S7. Population-level differences across behaviours, using raw scores, are visualized in Figure 3.

Figure 3

Heat Map for Scores of Immoral Behaviours of the Moral Foundations Boards for Each of the Studied Populations (Hadza, Datoga, Iraqw, USA). The Darker the Colour, the Higher the Score



4. Discussion

The aim of this study was to evaluate the core assumptions of MFT by testing its five-factor structure and examining group differences in moral judgment across three small-scale, non-industrialised populations: the Hadza, Datoga, and Iraqw. In addition to identifying differences between these groups, we also included a sample from United States to serve as a reference point, given that the vast majority of MFT research has been conducted in the United States and similar WEIRD samples. To overcome the methodological limitations of text-based instruments traditionally used in MFT research, we developed and implemented the Moral Foundations Boards—a novel, pictorial task that enabled the assessment of moral judgments in populations with low literacy and limited familiarity with formal survey tools. This approach allowed us to examine both the proposed five-factor structure of MFT and cultural variation in moral sensitivity. The study provided the first direct test of MFT in non-industrialised societies and revealed differences in how specific moral violations are judged within small-scale populations.

Our theory-driven analysis—based on the predefined five moral foundations—showed that sensitivity to moral violations differed across populations. Across all samples, Purity violations were rated as the most morally wrong, while Fairness and Loyalty were judged as the least severe. Group-level differences were especially evident in the domains of Care and Purity: both the Hadza and the Datoga were less sensitive to Care-related violations than participants from the United States, but more sensitive to violations related to Purity. The Iraqw showed no significant differences from any other group. No group-level differences were found for Fairness, Loyalty, or Authority.

In our bottom-up approach, we examined the underlying structure of MFT across all samples. Regardless of the method used, we were unable to replicate the original five-factor model proposed by MFT in any of the populations—except for the Moral Foundations Vignettes, which showed acceptable fit in the sample from the United States. The two-factor model, which distinguishes between individualizing and binding foundations, also failed to meet psychometric standards. Given these results, we shifted our focus to the item level, analysing moral sensitivity to individual behaviours. In the next step, we examined group differences in how specific moral violations were evaluated across populations.

Across all groups, behaviours related to Purity and Care were rated as the most morally wrong. For example, violations such as marrying one's daughter or having sex with a grandparent were judged particularly harshly. Likewise, violent acts in the Care domain—such as biting, hitting a child, or throwing a stone—received consistently high moral condemnation. However, interaction effects between population and individual behaviours revealed group differences. The Hadza and Datoga consistently rated most Care-related violations as less morally wrong than participants in the sample from the United States. A similar pattern was observed for several Purity-related behaviours: while these were still judged as serious transgressions, their severity was rated lower by the Hadza and Datoga compared to participants from the United States. In contrast, the Iraqw showed relatively few differences from the sample

from the United States and did not significantly diverge on most individual items.

Previous research using the Moral Foundations Questionnaire has shown that individuals from Eastern cultures tend to place greater emphasis on Purity and Loyalty compared to those from Western contexts, although Care typically remains the most highly valued moral concern overall (Doğruyol et al., 2019; Atari et al., 2023; Graham et al., 2011). Our results partially support this prediction: the Hadza and Datoga showed greater sensitivity to Purity violations than participants from the United States, but not to Loyalty violations. At the same time, both small-scale groups were significantly less sensitive to Care-related violations—although, consistent with previous findings, Care was still valued more highly than Fairness, Loyalty, and Authority. According to one of MFT's core assumptions—that the innate "first draft" of morality is shaped and refined through cultural learning—these group differences in moral sensitivity likely reflect the influence of distinct social and ecological environments.

Two distinct factors may help explain why Purity violations were judged more harshly by the Hadza and Datoga than by participants from the United States. First, some of the most strongly condemned items in the Moral Foundations Boards—such as marrying one's own daughter or having sex with a grandparent—directly implicate inbreeding (Kar & Swain, 2020). In small-scale populations like the Hadza and Datoga, where communities are relatively small and kin networks are tightly interwoven, the mating pool is limited, and the risk of mating with closely related individuals is higher than in large, urbanised societies. If not properly regulated, this can increase the likelihood of biological health issues in offspring due to the expression of recessive alleles in homozygous states—leading to greater susceptibility to complex diseases and reduced longevity (Kar & Swain, 2020). To mitigate these risks, both psychological aversions to incest and culturally enforced norms strongly prohibit such relationships. Among the Datoga, for example, clan exogamy is strictly enforced: individuals are forbidden from marrying within their own patrilineal clan, and such unions are regarded as serious moral violations. These prohibitions not only reduce genetic risk but also serve important social and economic functions, as marriages between unrelated families help forge alliances and expand cattle herds—benefiting both the wife's natal family and the husband's household (Tomikawa, 1978).

Second, other Purity-related behaviours included in the Moral Foundations Boards—such as frequent sexual intercourse or sex with strangers—may be more harshly judged in these communities because they carry greater health risks. In contexts with limited access to contraception and healthcare, promiscuous behaviours increase the likelihood of sexually transmitted infections and unintended pregnancies (Garcia et al., 2015). In contrast, participants from the United States—living in environments with widespread reproductive technologies and lower health risks—may perceive these same behaviours as less morally serious. This interpretation aligns with cross-cultural research on sociosexuality, which shows that in environments with a high disease burden, nutritional stress, and infant mortality, people tend to adopt more restrictive sexual norms and favour long-term mating strategies (Schmitt, 2005).

The Hadza and Datoga judged Care violations—behaviours associated with physical harm—less harshly than participants from the United States. Lower sensitivity to such violence

may result from differences in social learning shaped by local socio-ecological conditions. In small-scale societies, physical punishment is often a culturally accepted tool for regulating cooperation and enforcing social norms (Butovskaya, 2012; Garfield et al., 2023). Although popular imagery, such as the "noble savage" myth, portrays small-scale societies as inherently peaceful and non-violent, empirical research shows that interpersonal violence has been widespread throughout human history and remains common in many small-scale societies today (McCall & Shields, 2008). One illustrative example comes from Turkana warriors, the majority of whom consider it morally permissible to kill an infant or a child during a raid (Zefferman & Mathew, 2020).

In the Hadza, formal mechanisms of norm enforcement, such as police or courts, are largely absent or inconsistently available. As a result, individuals often rely on direct, interpersonal means of addressing social transgressions, including physical punishment. This reliance on personal enforcement may foster a greater tolerance for violence and a reduced tendency to moralise acts of physical harm. In contrast, larger, industrialised societies have institutionalised third-party punishment systems—such as police forces and judicial bodies—which relieve individuals of the need to punish wrongdoers themselves. In these contexts, violence is delegated to formal authorities, and everyday physical aggression may be viewed as more deviant or morally unacceptable (Fehr & Schurtenberger, 2018).

Formal mechanisms of norm enforcement, such as police or judicial systems, are largely absent or inconsistently available among the Hadza. Social transgressions are typically addressed through direct, interpersonal means, including physical punishment. The Datoga, by contrast, have a more structured form of communal justice. Clan assemblies, local community councils, and broader tribal meetings serve as established mechanisms for handling a wide range of moral violations, including murder, theft, sexual violence, and disrespect toward elders (Butovskaya, 2012, 2013). Offenders are routinely brought before these tribal courts and punished both physically (e.g., beating with sticks) and materially (e.g., fines). In severe cases, the punishment may include social ostracism—a ban on offering any form of help or assistance to the convicted individual. In contrast, larger, industrialised societies have institutionalised third-party punishment systems—such as police forces and judicial bodies—which relieve individuals of the need to punish wrongdoers themselves. In these contexts, violence is delegated to formal authorities, and everyday physical aggression may be viewed as more deviant or morally unacceptable (Fehr & Schurtenberger, 2018).

Both the Hadza and the Datoga make use of interpersonal violence as a common feature of everyday life (Butovskaya et al., 2015). Among the Hadza, conflicts often arise from jealousy, with both men and women sometimes responding with physical aggression after discovering a partner with a lover (Butovskaya, 2013). Disputes over resources—such as meat or honey—are also common, particularly among men. Among women, arguments may escalate into physical confrontations over stolen jewellery or digging sticks. For the Datoga, conflicts among men typically centre on cattle, pastureland, or water sources, while women report jealousy over mating partners and engage in retaliatory behaviours, such as punishing others for spreading gossip or competing over domestic tasks (Butovskaya, 2013). Conflict is especially frequent between co-

wives, who may clash over childrearing or household responsibilities. In addition, wife-beating is widespread and culturally accepted as a form of discipline among the Datoga (Butovskaya, 2012).

These patterns suggest that in the absence of formal enforcement systems, physical violence remains an integral part of the mechanisms regulating cooperation. As such, Hadza and Datoga participants may judge harm-based violations less harshly, not due to moral deficiency, but because such behaviours are normalised and functional within their social environments.

4.1. Limitations and Future Directions

Our study did not successfully replicate the five-factor structure proposed by MFT. Several explanations for this outcome are plausible. First, the novel Moral Foundations Boards task may lack sufficient psychometric sensitivity to detect the underlying moral dimensions. While it was designed to overcome limitations of text-based measures in low-literacy populations, it may require further refinement to improve its sensitivity and reliability. Future adaptations could explore more nuanced or expanded designs, though this presents practical challenges: more complex versions may overburden participants, particularly in small-scale societies with limited exposure to structured testing. Alternatively, increasing sample sizes could help address this issue. In particular, our sample for the Iraqw group may have been too small to detect subtle effects. The lack of group-level differences for domains such as Fairness, Loyalty, and Authority could therefore reflect limited statistical power rather than an absence of real variation across populations. Larger samples in future studies would allow for stronger inferences regarding the presence or absence of these effects.

Second, the theoretical model underlying MFT may not adequately capture the structure of moral intuitions across diverse populations. In our study, even when using well-established instruments, the expected five-factor structure did not emerge. Only the Moral Foundations Vignettes produced an acceptable fit. Moreover, the commonly proposed two-factor model (individualizing vs. binding foundations) also failed to demonstrate adequate fit across all instruments.

These model-related issues align with research that questions the structural validity of MFT. For instance, several studies have found that factor analyses often yield only two broad dimensions (individualizing and binding foundations) rather than the five distinct domains originally proposed (e.g., Van Leeuwen et al., 2012). Iurino and Saucier (2020) reported persistent problems with model convergence across populations, suggesting that the theoretical structure of MFT may not generalize reliably beyond WEIRD cultural contexts. Additionally, Voelkel and Brandt (2019) highlighted that the wording of items in the Moral Foundations Questionnaire can introduce systematic bias, potentially inflating ideological differences and contributing to artefactual findings.

In response to ongoing challenges regarding the structure and cross-cultural applicability of MFT, several researchers have proposed theoretical refinements and alternative frameworks. For example, Atari and colleagues (2023) suggested that the Fairness foundation should be divided into two distinct components—Proportionality and Equality—to better reflect the range of fairness-related concerns across cultures. In a broader effort to re-theorize morality, Curry

and colleagues (2019) introduced the Morality-as-Cooperation (MAC) framework. MAC proposes that moral values are biological and cultural solutions to recurrent problems of cooperation in human social life. Within this framework, they argue that MFT's Care and Purity foundations lack theoretical precision: Care conflates distinct cooperative mechanisms (e.g., kin altruism, reciprocity), and Purity pertains more to pathogen avoidance than to cooperative behaviour. In contrast, MAC identifies moral domains such as Family, Heroism, Reciprocity, and Property as distinct and evolutionarily grounded forms of moral behaviour.

These conceptual shifts have practical implications for interpreting our findings. When viewed through the lens of MAC, the behaviours most strongly condemned by participants—such as unprovoked aggression or unrestrained sexual activity—might reflect violations of Heroism, understood as a failure to build social status, project reliability, self-control. In this view, such behaviours undermine cooperative stability by signalling unpredictability or weakness. This reframing offers an alternative account of why certain acts are morally condemned, especially in small-scale societies where social cohesion and conflict resolution often depend on individuals signalling their status (Von Rueden et al., 2019).

4.2. Conclusions

This study presents the first investigation of MFT in small-scale societies, offering direct empirical insights from the Hadza hunter-gatherers, Datoga pastoralists, Iraqw agropastoralists, and a comparative sample of participants from the United States. To overcome the limitations of traditional, text-based instruments in low-literacy populations, we developed the Moral Foundations Boards—a novel, pictorial tool designed to capture moral judgments across culturally diverse contexts. While we did not replicate the five-factor structure proposed by MFT, our findings revealed cross-cultural differences in how specific types of moral violations were judged. Participants from the Hadza and Datoga communities evaluated Purity violations—such as promiscuous or incestuous sexual behaviour—more harshly than participants from the United States. In contrast, they showed reduced sensitivity to Care-related violations involving physical aggression. These patterns appear to reflect the distinct socioecological conditions of the populations studied.

In small-scale societies like the Hadza and Datoga, where kin networks are dense and access to contraception and healthcare is limited, sexual behaviours such as promiscuity or incest pose greater biological and social risks—making them more morally condemned. At the same time, physical punishment is often an accepted method of enforcing norms, which may lead to greater tolerance for interpersonal violence and reduced moral sensitivity to harm. In contrast, industrialised societies like the United States., with broader mating pools, lower disease risk, and formalised third-party enforcement systems, tend to judge sexual transgressions less harshly and physical aggression more severely.

Returning to the architectural metaphor introduced by the original MFT authors, in this study, we flew over a previously unexplored structure—shaped by distinct ecological and cultural forces—and took an aerial photograph to compare with others. Yet as we lay these images side by side, it becomes clear that we must also reconsider the kind of camera we are using. Future research must ask whether improved tools might reveal new patterns—or perhaps confirm that the blueprint itself needs to be revised.

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Supplementary Materials

Appendix 1

R code used to conduct sensitivity analysis for the study

```
library(lme4)
library(simr)

full_model <- glmer(Value ~ MFT * Population + (1 | ID),
                    family = poisson(link = "log"),
                    data = MOFOBO_RAW_DATABASE_LONG)

reduced_model <- glmer(Value ~ MFT + Population + (1 | ID),
                       family = poisson(link = "log"),
                       data = MOFOBO_RAW_DATABASE_LONG)

full_model_ext <- extend(full_model, along = "ID",
                         n = length(unique(MOFOBO_RAW_DATABASE_LONG$ID)))

interaction_terms <- grep("MFT.*:Population", names(fixef(full_model_ext)), value = TRUE)
for (term in interaction_terms) {
  fixef(full_model_ext)[term] <- 0.2
}

power_result <- powerSim(full_model_ext,
                         test = compare(reduced_model),
                         nsim = 1000)

summary(power_result)
```

Appendix 2

Pictorial items used in the Moral Foundations Boards

Care Foundation

Biting someone so that they bleed

Hitting your child

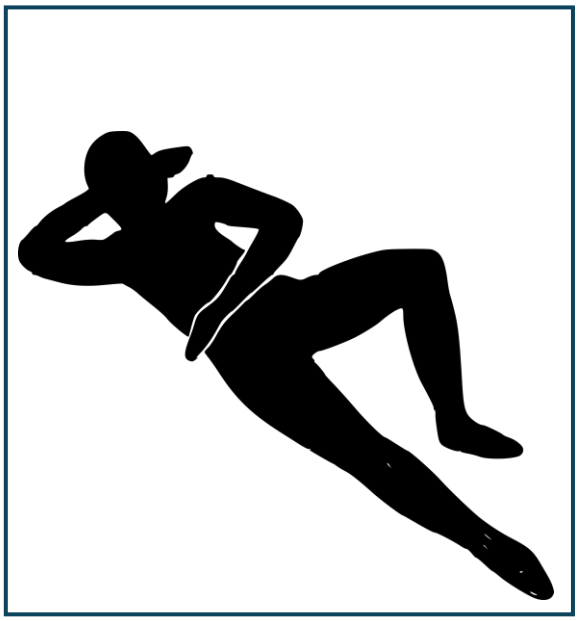
Hitting a person with a stick for no reason

Throwing a stone at another person

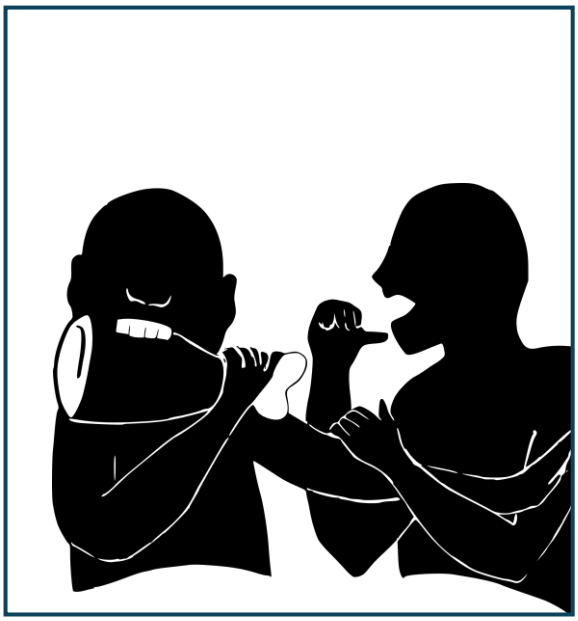
Fairness Foundation

Telling lies to someone

Stealing someone's clothes

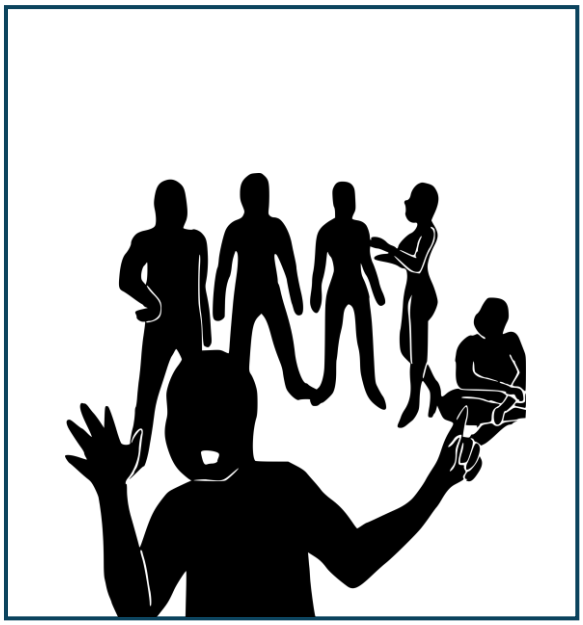


Lying to avoid work



Eating food that belongs to someone else

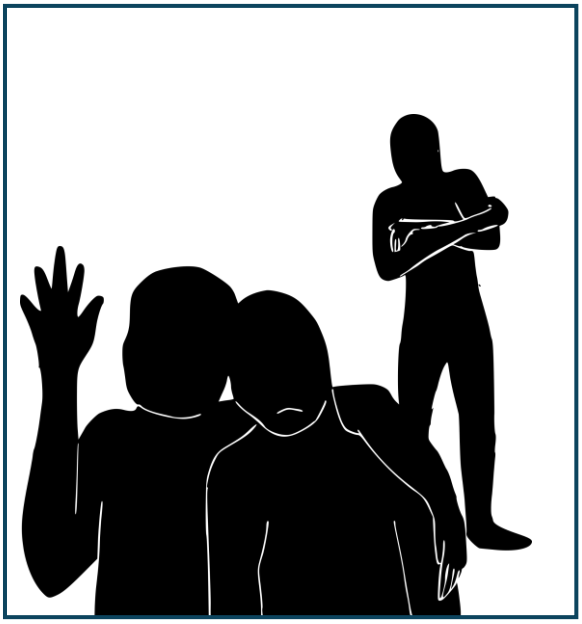
Loyalty Foundation



Speaking bad things about your own group

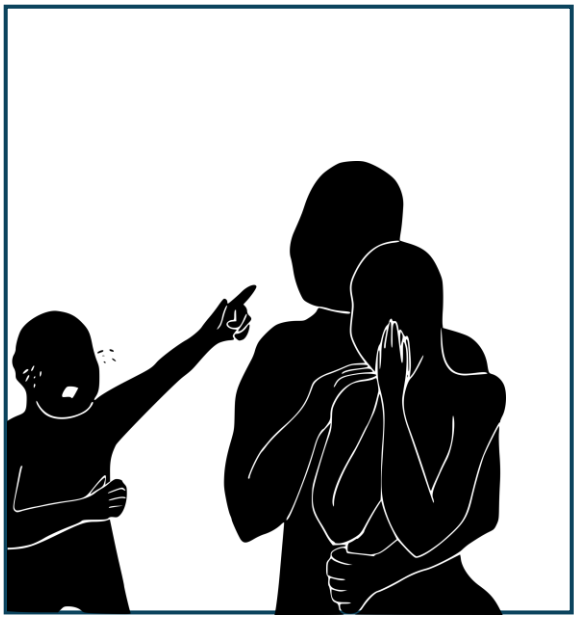
Speaking bad things about your own family

Trading with the enemy of your family



Helping your friend's enemy

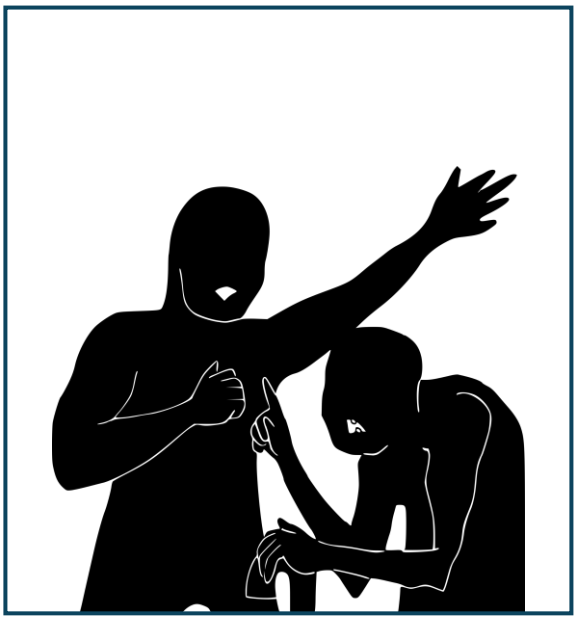
Authority Foundation



Insulting your father and mother

Ignoring father's commands

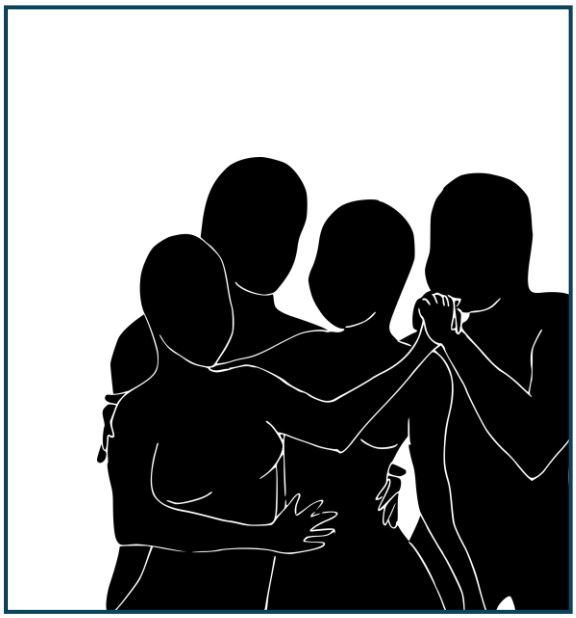
Being a man and performing women duties



Quarreling with an older person

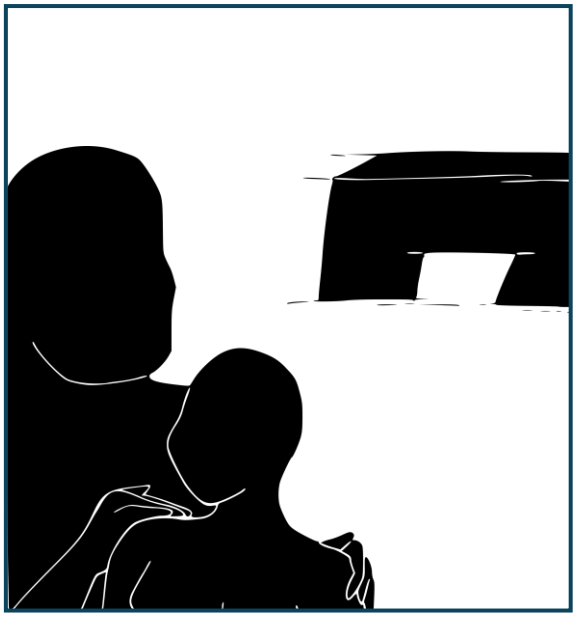
Purity Foundation

Having sex with a stranger



Having frequent sexual intercourse with different people

Having sex with a grandfather or grandmother



Marrying your own daughter

Table S1

Item Randomization Design for the Study

Set	Board	Item 1	Item 2	Item 3	Item 4	Item 5
1.	1.	7	6	3	4	11
	2.	6	15	19	1	18
	3.	18	5	2	8	20
	4.	20	7	6	9	16
	5.	11	8	16	5	10
	6.	19	11	13	12	17
	7.	17	12	9	3	2
	8.	4	13	20	7	14
	9.	10	18	4	15	12
	10.	2	9	10	13	1
	11.	1	14	5	3	8
	12.	14	19	15	17	16
2.	1.	17	20	14	10	6
	2.	15	2	11	14	7
	3.	16	4	2	11	1
	4.	12	16	8	6	13
	5.	9	14	18	6	5
	6.	10	17	7	18	8
	7.	3	1	13	20	15
	8.	8	4	15	19	9
	9.	13	3	11	16	18
	10.	20	10	12	19	3
	11.	19	5	17	2	4
	12.	5	7	1	9	12
3.	1.	18	3	7	5	13
	2.	2	13	6	10	5
	3.	15	9	5	11	20
	4.	14	10	16	7	19
	5.	1	11	9	10	19
	6.	6	17	3	9	11
	7.	4	12	14	20	8
	8.	16	6	12	2	15
	9.	16	1	17	18	20
	10.	12	18	1	14	4
	11.	8	15	4	17	13
	12.	3	8	19	7	2
4.	1.	15	20	6	4	3
	2.	9	18	10	11	4
	3.	4	16	5	3	17
	4.	11	12	20	1	19
	5.	3	2	14	15	10
	6.	9	11	8	13	14
	7.	7	5	10	12	15
	8.	2	19	18	20	7
	9.	18	16	12	8	2
	10.	1	8	7	17	6
	11.	13	19	16	5	9
	12.	13	1	17	14	6
5.	1.	5	6	19	12	3
	2.	6	4	8	1	10
	3.	7	13	11	15	12
	4.	8	9	13	20	10
	5.	13	6	18	4	19
	6.	11	14	2	18	15
	7.	14	2	4	9	5
	8.	17	20	5	16	11
	9.	19	17	3	8	18
	10.	20	7	1	2	16
	11.	12	15	9	17	7
	12.	10	14	3	16	1

6.	1.	2	17	10	12	14
	2.	8	15	20	6	16
	3.	14	7	8	19	11
	4.	16	10	15	13	4
	5.	20	3	17	2	9
	6.	3	9	4	16	7
	7.	5	19	12	1	18
	8.	11	8	1	5	15
	9.	18	3	4	10	12
	10.	19	13	14	6	2
	11.	1	5	13	7	17
	12.	9	11	6	18	20
7.	1.	15	9	19	8	3
	2.	4	16	7	18	19
	3.	16	1	3	13	14
	4.	12	2	20	13	8
	5.	10	20	5	7	6
	6.	18	16	9	12	14
	7.	17	10	11	19	20
	8.	7	12	2	6	8
	9.	5	14	6	3	11
	10.	1	10	15	17	9
	11.	2	4	1	11	17
	12.	5	15	18	4	13
8.	1.	8	12	9	3	1
	2.	13	2	20	1	19
	3.	14	7	8	15	1
	4.	6	19	16	15	10
	5.	15	3	2	17	5
	6.	17	18	13	10	7
	7.	10	11	8	5	16
	8.	12	17	11	4	6
	9.	19	4	20	14	5
	10.	6	18	16	9	2
	11.	3	13	18	7	11
	12.	20	14	12	4	9
9.	1.	16	6	19	14	12
	2.	11	1	6	2	18
	3.	7	1	9	6	4
	4.	4	8	17	16	2
	5.	14	10	7	19	3
	6.	2	12	10	11	13
	7.	18	20	14	15	17
	8.	7	11	15	20	3
	9.	9	19	12	5	13
	10.	10	3	1	8	18
	11.	15	5	16	9	17
	12.	8	20	13	5	4
10.	1.	5	2	7	4	10
	2.	17	6	11	8	19
	3.	20	18	17	14	8
	4.	17	13	18	16	7
	5.	12	5	15	1	6
	6.	1	16	3	12	20
	7.	4	9	11	3	16
	8.	13	15	14	18	9
	9.	19	4	2	1	15
	10.	9	8	19	2	10
	11.	6	3	10	20	13
	12.	11	7	5	14	12

Table S2
Fixed Effects Parameter Estimates for the Top-Down Model

					95% Exp(B) Confidence Interval			
Names	Effect	Estimate	SE	exp(B)	Lower	Upper	z	p
(Intercept)	(Intercept)	1.371	0.007	3.940	3.884	3.996	189.649	< .001
MFT1	Fairness - Care	-0.188	0.023	0.829	0.792	0.867	-8.098	< .001
MFT2	Loyalty - Care	-0.186	0.024	0.830	0.792	0.869	-7.925	< .001
MFT3	Authority - Care	-0.142	0.023	0.867	0.829	0.907	-6.232	< .001
MFT4	Purity - Care	0.241	0.021	1.273	1.222	1.326	11.518	< .001
Population1	Hadza - USA	0.005	0.015	1.005	0.976	1.035	0.353	0.724
Population2	Datoga - USA	-0.019	0.015	0.982	0.953	1.011	-1.227	0.220
Population3	Iraqw - USA	0.016	0.022	1.016	0.974	1.059	0.720	0.472
MFT1 ✻ Population1	Fairness - Care ✻ Hadza - USA	0.347	0.048	1.415	1.288	1.556	7.188	< .001
MFT2 ✻ Population1	Loyalty - Care ✻ Hadza - USA	0.184	0.048	1.202	1.094	1.322	3.816	< .001
MFT3 ✻ Population1	Authority - Care ✻ Hadza - USA	0.324	0.048	1.383	1.258	1.520	6.721	< .001
MFT4 ✻ Population1	Purity - Care ✻ Hadza - USA	0.410	0.044	1.507	1.384	1.642	9.400	< .001
MFT1 ✻ Population2	Fairness - Care ✻ Datoga - USA	0.376	0.050	1.456	1.321	1.605	7.574	< .001
MFT2 ✻ Population2	Loyalty - Care ✻ Datoga - USA	0.227	0.049	1.255	1.139	1.383	4.599	< .001
MFT3 ✻ Population2	Authority - Care ✻ Datoga - USA	0.412	0.049	1.510	1.372	1.662	8.434	< .001
MFT4 ✻ Population2	Purity - Care ✻ Datoga - USA	0.523	0.044	1.687	1.547	1.839	11.815	< .001
MFT1 ✻ Population3	Fairness - Care ✻ Iraqw - USA	0.232	0.068	1.261	1.103	1.442	3.397	< .001
MFT2 ✻ Population3	Loyalty - Care ✻ Iraqw - USA	0.002	0.070	1.002	0.874	1.149	0.031	0.975
MFT3 ✻ Population3	Authority - Care ✻ Iraqw - USA	0.292	0.067	1.339	1.175	1.527	4.368	< .001
MFT4 ✻ Population3	Purity - Care ✻ Iraqw - USA	0.241	0.062	1.272	1.127	1.437	3.881	< .001

Table S3

Post Hoc Comparisons - MFT for the Top-Down Model

Comparison						
MFT		MFT	exp(B)	SE	z	$p_{bonferroni}$
Authority	-	Purity	0.681	0.015	-17.847	< .001
Care	-	Authority	1.153	0.026	6.232	< .001
Care	-	Fairness	1.207	0.028	8.098	< .001
Care	-	Loyalty	1.205	0.028	7.925	< .001
Care	-	Purity	0.786	0.016	-11.518	< .001
Fairness	-	Authority	0.955	0.023	-1.923	0.545
Fairness	-	Loyalty	0.998	0.024	-0.064	1.000
Fairness	-	Purity	0.651	0.014	-19.613	< .001
Loyalty	-	Authority	0.957	0.023	-1.834	0.667
Loyalty	-	Purity	0.652	0.014	-19.251	< .001

Table S4

Post Hoc Comparisons - MFT ✻ Population for the Top-Down Model

Comparison								
MFT	Population		MFT	Population	exp(B)	SE	z	$p_{bonferroni}$
Authority	Datoga	-	Authority	Iraqw	0.934	0.052	-1.217	1.000
Authority	Datoga	-	Care	Iraqw	0.839	0.045	-3.260	0.212
Authority	Datoga	-	Fairness	Iraqw	1.019	0.059	0.333	1.000
Authority	Datoga	-	Loyalty	Iraqw	1.119	0.067	1.884	1.000
Authority	Datoga	-	Purity	Datoga	0.633	0.025	-11.432	< .001
Authority	Datoga	-	Purity	Iraqw	0.695	0.035	-7.179	< .001
Authority	Hadza	-	Authority	Datoga	0.990	0.044	-0.222	1.000
Authority	Hadza	-	Authority	Iraqw	0.925	0.052	-1.392	1.000
Authority	Hadza	-	Care	Datoga	1.003	0.045	0.067	1.000
Authority	Hadza	-	Care	Iraqw	0.831	0.045	-3.437	0.112
Authority	Hadza	-	Fairness	Datoga	1.055	0.048	1.196	1.000
Authority	Hadza	-	Fairness	Iraqw	1.009	0.058	0.161	1.000
Authority	Hadza	-	Loyalty	Datoga	1.068	0.048	1.448	1.000
Authority	Hadza	-	Loyalty	Iraqw	1.108	0.066	1.716	1.000
Authority	Hadza	-	Purity	Datoga	0.626	0.025	-11.643	< .001
Authority	Hadza	-	Purity	Hadza	0.648	0.026	-10.721	< .001
Authority	Hadza	-	Purity	Iraqw	0.688	0.035	-7.360	< .001
Authority	Iraqw	-	Purity	Iraqw	0.744	0.045	-4.849	< .001
Authority	USA	-	Authority	Datoga	0.918	0.032	-2.453	1.000
Authority	USA	-	Authority	Hadza	0.927	0.033	-2.163	1.000
Authority	USA	-	Authority	Iraqw	0.857	0.042	-3.153	0.307
Authority	USA	-	Care	Datoga	0.929	0.033	-2.076	1.000
Authority	USA	-	Care	Hadza	0.859	0.029	-4.436	0.002
Authority	USA	-	Care	Iraqw	0.770	0.036	-5.618	< .001
Authority	USA	-	Fairness	Datoga	0.978	0.035	-0.617	1.000
Authority	USA	-	Fairness	Hadza	0.930	0.033	-2.047	1.000
Authority	USA	-	Fairness	Iraqw	0.935	0.048	-1.316	1.000
Authority	USA	-	Loyalty	Datoga	0.989	0.036	-0.293	1.000
Authority	USA	-	Loyalty	Hadza	0.955	0.034	-1.290	1.000
Authority	USA	-	Loyalty	Iraqw	1.026	0.054	0.492	1.000
Authority	USA	-	Purity	Datoga	0.581	0.017	-18.427	< .001
Authority	USA	-	Purity	Hadza	0.601	0.018	-17.060	< .001
Authority	USA	-	Purity	Iraqw	0.637	0.027	-10.494	< .001
Authority	USA	-	Purity	USA	0.706	0.015	-16.829	< .001
Care	Datoga	-	Authority	Datoga	0.987	0.044	-0.289	1.000
Care	Datoga	-	Authority	Iraqw	0.922	0.052	-1.445	1.000
Care	Datoga	-	Care	Iraqw	0.828	0.045	-3.490	0.092
Care	Datoga	-	Fairness	Datoga	1.052	0.048	1.130	1.000
Care	Datoga	-	Fairness	Iraqw	1.006	0.058	0.110	1.000
Care	Datoga	-	Loyalty	Datoga	1.065	0.048	1.382	1.000
Care	Datoga	-	Loyalty	Iraqw	1.104	0.066	1.665	1.000
Care	Datoga	-	Purity	Datoga	0.625	0.025	-11.712	< .001
Care	Datoga	-	Purity	Iraqw	0.686	0.035	-7.417	< .001
Care	Hadza	-	Authority	Datoga	1.068	0.047	1.504	1.000
Care	Hadza	-	Authority	Hadza	1.078	0.047	1.726	1.000

Care	Hadza	-	Authority	Iraqw	0.998	0.055	-0.044	1.000
Care	Hadza	-	Care	Datoga	1.082	0.047	1.793	1.000
Care	Hadza	-	Care	Iraqw	0.896	0.048	-2.063	1.000
Care	Hadza	-	Fairness	Datoga	1.138	0.050	2.920	0.664
Care	Hadza	-	Fairness	Hadza	1.083	0.047	1.816	1.000
Care	Hadza	-	Fairness	Iraqw	1.088	0.062	1.486	1.000
Care	Hadza	-	Loyalty	Datoga	1.151	0.051	3.172	0.288
Care	Hadza	-	Loyalty	Hadza	1.111	0.049	2.399	1.000
Care	Hadza	-	Loyalty	Iraqw	1.195	0.070	3.013	0.492
Care	Hadza	-	Purity	Datoga	0.676	0.027	-9.994	< .001
Care	Hadza	-	Purity	Hadza	0.699	0.028	-9.061	< .001
Care	Hadza	-	Purity	Iraqw	0.742	0.037	-5.961	< .001
Care	Iraqw	-	Authority	Iraqw	1.113	0.071	1.688	1.000
Care	Iraqw	-	Fairness	Iraqw	1.215	0.079	2.986	0.536
Care	Iraqw	-	Loyalty	Iraqw	1.333	0.089	4.299	0.003
Care	Iraqw	-	Purity	Iraqw	0.828	0.049	-3.186	0.274
Care	USA	-	Authority	Datoga	1.368	0.046	9.245	< .001
Care	USA	-	Authority	Hadza	1.382	0.047	9.496	< .001
Care	USA	-	Authority	Iraqw	1.278	0.061	5.109	< .001
Care	USA	-	Authority	USA	1.491	0.030	19.568	< .001
Care	USA	-	Care	Datoga	1.386	0.047	9.580	< .001
Care	USA	-	Care	Hadza	1.281	0.042	7.524	< .001
Care	USA	-	Care	Iraqw	1.148	0.052	3.021	0.478
Care	USA	-	Fairness	Datoga	1.458	0.051	10.828	< .001
Care	USA	-	Fairness	Hadza	1.387	0.047	9.597	< .001
Care	USA	-	Fairness	Iraqw	1.395	0.070	6.649	< .001
Care	USA	-	Fairness	USA	1.532	0.032	20.735	< .001
Care	USA	-	Loyalty	Datoga	1.475	0.052	11.105	< .001
Care	USA	-	Loyalty	Hadza	1.424	0.049	10.250	< .001
Care	USA	-	Loyalty	Iraqw	1.531	0.080	8.145	< .001
Care	USA	-	Loyalty	USA	1.336	0.026	14.659	< .001
Care	USA	-	Purity	Datoga	0.866	0.024	-5.138	< .001
Care	USA	-	Purity	Hadza	0.896	0.025	-3.870	0.021
Care	USA	-	Purity	Iraqw	0.950	0.040	-1.211	1.000
Care	USA	-	Purity	USA	1.053	0.020	2.810	0.941
Fairness	Datoga	-	Authority	Datoga	0.938	0.042	-1.418	1.000
Fairness	Datoga	-	Authority	Iraqw	0.876	0.049	-2.337	1.000
Fairness	Datoga	-	Care	Iraqw	0.787	0.043	-4.397	0.002
Fairness	Datoga	-	Fairness	Iraqw	0.956	0.056	-0.769	1.000
Fairness	Datoga	-	Loyalty	Datoga	1.012	0.046	0.252	1.000
Fairness	Datoga	-	Loyalty	Iraqw	1.049	0.063	0.803	1.000
Fairness	Datoga	-	Purity	Datoga	0.594	0.024	-12.772	< .001
Fairness	Datoga	-	Purity	Iraqw	0.652	0.033	-8.334	< .001
Fairness	Hadza	-	Authority	Datoga	0.986	0.044	-0.311	1.000
Fairness	Hadza	-	Authority	Hadza	0.996	0.044	-0.089	1.000
Fairness	Hadza	-	Authority	Iraqw	0.921	0.052	-1.462	1.000
Fairness	Hadza	-	Care	Datoga	0.999	0.045	-0.022	1.000
Fairness	Hadza	-	Care	Iraqw	0.827	0.045	-3.509	0.086
Fairness	Hadza	-	Fairness	Datoga	1.051	0.048	1.107	1.000

Fairness	Hadza	-	Fairness	Iraqw	1.005	0.058	0.092	1.000
Fairness	Hadza	-	Loyalty	Datoga	1.064	0.048	1.359	1.000
Fairness	Hadza	-	Loyalty	Hadza	1.027	0.046	0.584	1.000
Fairness	Hadza	-	Loyalty	Iraqw	1.103	0.066	1.648	1.000
Fairness	Hadza	-	Purity	Datoga	0.624	0.025	-11.728	< .001
Fairness	Hadza	-	Purity	Hadza	0.646	0.026	-10.807	< .001
Fairness	Hadza	-	Purity	Iraqw	0.685	0.035	-7.433	< .001
Fairness	Iraqw	-	Authority	Iraqw	0.916	0.061	-1.304	1.000
Fairness	Iraqw	-	Loyalty	Iraqw	1.097	0.077	1.329	1.000
Fairness	Iraqw	-	Purity	Iraqw	0.682	0.043	-6.118	< .001
Fairness	USA	-	Authority	Datoga	0.893	0.031	-3.223	0.241
Fairness	USA	-	Authority	Hadza	0.902	0.032	-2.931	0.642
Fairness	USA	-	Authority	Iraqw	0.834	0.041	-3.707	0.040
Fairness	USA	-	Authority	USA	0.973	0.022	-1.215	1.000
Fairness	USA	-	Care	Datoga	0.904	0.032	-2.844	0.846
Fairness	USA	-	Care	Hadza	0.836	0.029	-5.221	< .001
Fairness	USA	-	Care	Iraqw	0.749	0.035	-6.195	< .001
Fairness	USA	-	Fairness	Datoga	0.952	0.034	-1.373	1.000
Fairness	USA	-	Fairness	Hadza	0.905	0.032	-2.814	0.929
Fairness	USA	-	Fairness	Iraqw	0.910	0.046	-1.852	1.000
Fairness	USA	-	Loyalty	Datoga	0.963	0.035	-1.047	1.000
Fairness	USA	-	Loyalty	Hadza	0.929	0.033	-2.051	1.000
Fairness	USA	-	Loyalty	Iraqw	0.999	0.053	-0.024	1.000
Fairness	USA	-	Loyalty	USA	0.872	0.019	-6.251	< .001
Fairness	USA	-	Purity	Datoga	0.565	0.017	-19.277	< .001
Fairness	USA	-	Purity	Hadza	0.584	0.018	-17.906	< .001
Fairness	USA	-	Purity	Iraqw	0.620	0.027	-11.111	< .001
Fairness	USA	-	Purity	USA	0.687	0.014	-18.009	< .001
Loyalty	Datoga	-	Authority	Datoga	0.927	0.042	-1.670	1.000
Loyalty	Datoga	-	Authority	Iraqw	0.866	0.049	-2.537	1.000
Loyalty	Datoga	-	Care	Iraqw	0.778	0.042	-4.601	< .001
Loyalty	Datoga	-	Fairness	Iraqw	0.945	0.055	-0.966	1.000
Loyalty	Datoga	-	Loyalty	Iraqw	1.037	0.062	0.610	1.000
Loyalty	Datoga	-	Purity	Datoga	0.587	0.024	-13.008	< .001
Loyalty	Datoga	-	Purity	Iraqw	0.644	0.033	-8.540	< .001
Loyalty	Hadza	-	Authority	Datoga	0.961	0.043	-0.895	1.000
Loyalty	Hadza	-	Authority	Hadza	0.970	0.044	-0.673	1.000
Loyalty	Hadza	-	Authority	Iraqw	0.898	0.050	-1.923	1.000
Loyalty	Hadza	-	Care	Datoga	0.973	0.044	-0.607	1.000
Loyalty	Hadza	-	Care	Iraqw	0.806	0.044	-3.977	0.013
Loyalty	Hadza	-	Fairness	Datoga	1.024	0.047	0.523	1.000
Loyalty	Hadza	-	Fairness	Iraqw	0.979	0.057	-0.361	1.000
Loyalty	Hadza	-	Loyalty	Datoga	1.036	0.047	0.776	1.000
Loyalty	Hadza	-	Loyalty	Iraqw	1.075	0.064	1.204	1.000
Loyalty	Hadza	-	Purity	Datoga	0.608	0.025	-12.280	< .001
Loyalty	Hadza	-	Purity	Hadza	0.629	0.026	-11.364	< .001
Loyalty	Hadza	-	Purity	Iraqw	0.667	0.034	-7.908	< .001
Loyalty	Iraqw	-	Authority	Iraqw	0.835	0.057	-2.627	1.000
Loyalty	Iraqw	-	Purity	Iraqw	0.621	0.040	-7.391	< .001

Loyalty	USA	-	Authority	Datoga	1.024	0.036	0.679	1.000
Loyalty	USA	-	Authority	Hadza	1.034	0.036	0.960	1.000
Loyalty	USA	-	Authority	Iraqw	0.957	0.047	-0.914	1.000
Loyalty	USA	-	Authority	USA	1.116	0.024	5.040	< .001
Loyalty	USA	-	Care	Datoga	1.037	0.036	1.044	1.000
Loyalty	USA	-	Care	Hadza	0.959	0.032	-1.242	1.000
Loyalty	USA	-	Care	Iraqw	0.859	0.040	-3.283	0.195
Loyalty	USA	-	Fairness	Datoga	1.091	0.039	2.454	1.000
Loyalty	USA	-	Fairness	Hadza	1.038	0.036	1.072	1.000
Loyalty	USA	-	Fairness	Iraqw	1.044	0.053	0.845	1.000
Loyalty	USA	-	Loyalty	Datoga	1.104	0.040	2.766	1.000
Loyalty	USA	-	Loyalty	Hadza	1.066	0.038	1.804	1.000
Loyalty	USA	-	Loyalty	Iraqw	1.145	0.060	2.572	1.000
Loyalty	USA	-	Purity	Datoga	0.648	0.019	-14.935	< .001
Loyalty	USA	-	Purity	Hadza	0.670	0.020	-13.588	< .001
Loyalty	USA	-	Purity	Iraqw	0.711	0.030	-7.995	< .001
Loyalty	USA	-	Purity	USA	0.788	0.016	-11.884	< .001
Purity	Datoga	-	Authority	Iraqw	1.477	0.078	7.416	< .001
Purity	Datoga	-	Care	Iraqw	1.326	0.067	5.601	< .001
Purity	Datoga	-	Fairness	Iraqw	1.611	0.088	8.772	< .001
Purity	Datoga	-	Loyalty	Iraqw	1.768	0.100	10.100	< .001
Purity	Datoga	-	Purity	Iraqw	1.098	0.052	1.988	1.000
Purity	Hadza	-	Authority	Datoga	1.528	0.062	10.509	< .001
Purity	Hadza	-	Authority	Iraqw	1.427	0.075	6.740	< .001
Purity	Hadza	-	Care	Datoga	1.547	0.063	10.790	< .001
Purity	Hadza	-	Care	Iraqw	1.282	0.065	4.903	< .001
Purity	Hadza	-	Fairness	Datoga	1.628	0.067	11.860	< .001
Purity	Hadza	-	Fairness	Iraqw	1.557	0.085	8.114	< .001
Purity	Hadza	-	Loyalty	Datoga	1.647	0.068	12.098	< .001
Purity	Hadza	-	Loyalty	Iraqw	1.709	0.097	9.463	< .001
Purity	Hadza	-	Purity	Datoga	0.966	0.034	-0.960	1.000
Purity	Hadza	-	Purity	Iraqw	1.061	0.050	1.256	1.000
Purity	USA	-	Authority	Datoga	1.299	0.044	7.679	< .001
Purity	USA	-	Authority	Hadza	1.312	0.045	7.935	< .001
Purity	USA	-	Authority	Iraqw	1.213	0.058	4.017	0.011
Purity	USA	-	Care	Datoga	1.315	0.045	8.015	< .001
Purity	USA	-	Care	Hadza	1.216	0.040	5.915	< .001
Purity	USA	-	Care	Iraqw	1.090	0.050	1.875	1.000
Purity	USA	-	Fairness	Datoga	1.384	0.048	9.299	< .001
Purity	USA	-	Fairness	Hadza	1.317	0.045	8.038	< .001
Purity	USA	-	Fairness	Iraqw	1.324	0.066	5.598	< .001
Purity	USA	-	Loyalty	Datoga	1.400	0.049	9.583	< .001
Purity	USA	-	Loyalty	Hadza	1.352	0.047	8.707	< .001
Purity	USA	-	Loyalty	Iraqw	1.453	0.076	7.137	< .001
Purity	USA	-	Purity	Datoga	0.822	0.023	-6.954	< .001
Purity	USA	-	Purity	Hadza	0.850	0.024	-5.669	< .001
Purity	USA	-	Purity	Iraqw	0.902	0.038	-2.447	1.000

Table S5

Correlation matrix for MFT measures used among the US sample

			MFB					MFQ					MFV				
			C	F	L	A	P	C	F	L	A	P	C	F	L	A	P
MFB	C	Pearson's r	—														
		p-value	—														
	F	Pearson's r	-0.164	—													
		p-value	0.004	—													
	L	Pearson's r	-0.316	-0.163	—												
		p-value	< .001	0.005	—												
	A	Pearson's r	-0.385	-0.105	-0.046	—											
		p-value	< .001	0.068	0.428	—											
	P	Pearson's r	-0.215	-0.481	-0.282	-0.291	—										
		p-value	< .001	< .001	< .001	< .001	—										
MFQ	C	Pearson's r	0.280	-0.179	-0.124	-0.183	0.130	—									
		p-value	< .001	0.002	0.032	0.001	0.024	—									
	F	Pearson's r	0.178	-0.134	-0.020	-0.152	0.084	0.805	—								
		p-value	0.002	0.020	0.728	0.008	0.146	< .001	—								
	L	Pearson's r	-0.136	-0.237	0.085	0.143	0.145	0.508	0.526	—							
		p-value	0.018	< .001	0.141	0.013	0.012	< .001	< .001	—							
	A	Pearson's r	-0.003	-0.209	-0.062	0.071	0.166	0.635	0.611	0.790	—						
		p-value	0.957	< .001	0.284	0.221	0.004	< .001	< .001	< .001	—						
	P	Pearson's r	-0.050	-0.277	-0.113	0.007	0.346	0.573	0.509	0.651	0.714	—					
		p-value	0.389	< .001	0.051	0.902	< .001	< .001	< .001	< .001	< .001	—					
MFV	C	Pearson's r	0.263	-0.090	-0.093	-0.145	0.022	0.513	0.467	0.196	0.275	0.237	—				
		p-value	< .001	0.121	0.106	0.012	0.706	< .001	< .001	< .001	< .001	< .001	—				
	F	Pearson's r	0.109	-0.062	-0.114	-0.063	0.085	0.537	0.529	0.427	0.529	0.442	0.518	—			
		p-value	0.059	0.286	0.049	0.280	0.142	< .001	< .001	< .001	< .001	< .001	< .001	—			
	L	Pearson's r	-0.158	-0.072	0.109	0.124	0.024	0.162	0.221	0.353	0.334	0.262	0.144	0.236	—		
		p-value	0.006	0.215	0.059	0.032	0.679	0.005	< .001	< .001	< .001	< .001	0.012	< .001	—		
	A	Pearson's r	-0.144	-0.090	-0.054	0.110	0.155	0.299	0.352	0.533	0.501	0.427	0.323	0.632	0.424	—	
		p-value	0.013	0.119	0.353	0.058	0.007	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	—	
	P	Pearson's r	0.064	-0.182	-0.098	-0.127	0.259	0.511	0.485	0.399	0.493	0.451	0.508	0.569	0.298	0.509	—
		p-value	0.272	0.002	0.090	0.027	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	—

Note. MFB scores were transformed for ease of interpretation. The scale was adjusted to start at 1 (instead of –12) and reversed so that higher scores indicate greater sensitivity to moral violations.

MFB—Moral Foundations Boards; MFQ—Moral Foundations Questionnaire; MFV—Moral Foundations Vignettes; C–Care; F–Fairness; L–Loyalty; A–Authority; P–Purity

Table S6

Fixed Effects Parameter Estimates from a Model with Participants and Population as Cluster Variables (Random Intercepts) and Moral Behaviour as a Fixed Effect

					95% Exp(B) Confidence Interval			
Names	Effect	Estimate	SE	exp(B)	Lower	Upper	z	p
(Intercept)	(Intercept)	1.365	0.005	3.915	3.875	3.956	259.069	< .001
Item1	Author_Father - Author_Duties	0.341	0.038	1.407	1.305	1.516	8.897	< .001
Item2	Author_Parents - Author_Duties	0.496	0.037	1.643	1.527	1.767	13.348	< .001
Item3	Author_Quarrel - Author_Duties	0.436	0.038	1.546	1.436	1.664	11.584	< .001
Item4	Care_Bite - Author_Duties	0.600	0.036	1.823	1.697	1.958	16.456	< .001
Item5	Care_Child - Author_Duties	0.648	0.036	1.912	1.781	2.053	17.922	< .001
Item6	Care_Stick - Author_Duties	0.628	0.036	1.873	1.745	2.012	17.294	< .001
Item7	Care_Stone - Author_Duties	0.578	0.037	1.783	1.659	1.916	15.792	< .001
Item8	Fair_Cloth - Author_Duties	0.429	0.038	1.536	1.426	1.653	11.391	< .001
Item9	Fair_Food - Author_Duties	0.265	0.039	1.304	1.208	1.408	6.814	< .001
Item10	Fair_Lies - Author_Duties	0.345	0.038	1.413	1.310	1.523	9.017	< .001
Item11	Fair_Work - Author_Duties	0.147	0.040	1.158	1.071	1.253	3.676	< .001
Item12	Loyal_Family - Author_Duties	0.409	0.038	1.506	1.398	1.621	10.821	< .001
Item13	Loyal_Friend - Author_Duties	0.364	0.038	1.438	1.335	1.550	9.525	< .001
Item14	Loyal_Trade - Author_Duties	0.372	0.038	1.451	1.347	1.564	9.778	< .001
Item15	Loyal_Tribe - Author_Duties	0.367	0.038	1.444	1.340	1.556	9.627	< .001
Item16	Purity_Freq - Author_Duties	0.610	0.036	1.841	1.714	1.977	16.756	< .001
Item17	Purity_Granny - Author_Duties	0.827	0.035	2.287	2.135	2.450	23.542	< .001
Item18	Purity_Marry - Author_Duties	0.897	0.035	2.451	2.290	2.624	25.785	< .001
Item19	Purity_Stranger - Author_Duties	0.450	0.038	1.568	1.456	1.687	11.984	< .001

Figure S7

Fixed Effects Parameter Estimates from a Model with Participants as Cluster Variables (Random Intercepts) and Population as well as Moral Behaviour as a Fixed Effect

					95% Exp(B) Confidence Interval			
Names	**Effect**	**Estimate**	**SE**	**exp(B)**	**Lower**	**Upper**	**z**	**p**
(Intercept)	(Intercept)	1.361	0.007	3.899	3.843	3.955	185.505	< .001
Population1	Hadza - USA	0.019	0.015	1.019	0.989	1.049	1.236	0.216
Population2	Datoga - USA	-0.006	0.015	0.994	0.964	1.024	-0.414	0.679
Population3	Iraqw - USA	0.007	0.022	1.007	0.964	1.051	0.304	0.761
Item1	Author_Father - Author_Duties	0.329	0.048	1.390	1.264	1.528	6.814	< .001
Item2	Author_Parents - Author_Duties	0.389	0.048	1.475	1.342	1.620	8.094	< .001
Item3	Author_Quarrel - Author_Duties	0.381	0.048	1.464	1.332	1.609	7.902	< .001
Item4	Care_Bite - Author_Duties	0.409	0.048	1.506	1.369	1.656	8.442	< .001
Item5	Care_Child - Author_Duties	0.461	0.048	1.585	1.443	1.742	9.609	< .001
Item6	Care_Stick - Author_Duties	0.443	0.048	1.558	1.418	1.711	9.227	< .001
Item7	Care_Stone - Author_Duties	0.437	0.048	1.548	1.410	1.701	9.131	< .001
Item8	Fair_Cloth - Author_Duties	0.347	0.049	1.415	1.287	1.557	7.138	< .001
Item9	Fair_Food - Author_Duties	0.216	0.050	1.241	1.125	1.369	4.301	< .001
Item10	Fair_Lies - Author_Duties	0.272	0.049	1.312	1.191	1.445	5.493	< .001
Item11	Fair_Work - Author_Duties	0.150	0.051	1.162	1.052	1.283	2.966	0.003
Item12	Loyal_Family - Author_Duties	0.309	0.049	1.362	1.238	1.500	6.308	< .001
Item13	Loyal_Friend - Author_Duties	0.193	0.052	1.213	1.094	1.344	3.685	< .001
Item14	Loyal_Trade - Author_Duties	0.154	0.053	1.167	1.051	1.295	2.895	0.004
Item15	Loyal_Tribe - Author_Duties	0.299	0.049	1.348	1.225	1.484	6.118	< .001
Item16	Purity_Freq - Author_Duties	0.626	0.046	1.870	1.710	2.046	13.712	< .001
Item17	Purity_Granny - Author_Duties	0.768	0.045	2.156	1.974	2.355	17.040	< .001
Item18	Purity_Marry - Author_Duties	0.817	0.044	2.263	2.075	2.469	18.386	< .001
Item19	Purity_Stranger - Author_Duties	0.451	0.048	1.570	1.430	1.725	9.432	< .001

Population1 ✻ Item1	Hadza - USA ✻ Author_Father - Author_Duties	-0.381	0.100	0.683	0.562	0.831	-3.808	< .001
Population2 ✻ Item1	Datoga - USA ✻ Author_Father - Author_Duties	-0.348	0.099	0.706	0.582	0.857	-3.529	< .001
Population3 ✻ Item1	Iraqw - USA ✻ Author_Father - Author_Duties	0.211	0.146	1.235	0.929	1.644	1.452	0.147
Population1 ✻ Item2	Hadza - USA ✻ Author_Parents - Author_Duties	-0.611	0.098	0.543	0.448	0.658	-6.220	< .001
Population2 ✻ Item2	Datoga - USA ✻ Author_Parents - Author_Duties	-0.803	0.101	0.448	0.367	0.547	-7.918	< .001
Population3 ✻ Item2	Iraqw - USA ✻ Author_Parents - Author_Duties	0.087	0.142	1.091	0.827	1.440	0.618	0.537
Population1 ✻ Item3	Hadza - USA ✻ Author_Quarrel - Author_Duties	-0.482	0.099	0.618	0.509	0.750	-4.876	< .001
Population2 ✻ Item3	Datoga - USA ✻ Author_Quarrel - Author_Duties	-0.387	0.096	0.679	0.562	0.820	-4.017	< .001
Population3 ✻ Item3	Iraqw - USA ✻ Author_Quarrel - Author_Duties	0.043	0.146	1.044	0.784	1.391	0.296	0.767
Population1 ✻ Item4	Hadza - USA ✻ Care_Bite - Author_Duties	-0.778	0.098	0.459	0.379	0.557	-7.935	< .001
Population2 ✻ Item4	Datoga - USA ✻ Care_Bite - Author_Duties	-0.839	0.098	0.432	0.356	0.524	-8.517	< .001
Population3 ✻ Item4	Iraqw - USA ✻ Care_Bite - Author_Duties	-0.233	0.146	0.792	0.596	1.054	-1.600	0.110
Population1 ✻ Item5	Hadza - USA ✻ Care_Child - Author_Duties	-0.699	0.096	0.497	0.412	0.599	-7.316	< .001
Population2 ✻ Item5	Datoga - USA ✻ Care_Child - Author_Duties	-0.869	0.098	0.419	0.346	0.508	-8.862	< .001
Population3 ✻ Item5	Iraqw - USA ✻ Care_Child - Author_Duties	-0.244	0.145	0.784	0.591	1.040	-1.685	0.092
Population1 ✻ Item6	Hadza - USA ✻ Care_Stick - Author_Duties	-0.745	0.097	0.475	0.393	0.574	-7.697	< .001
Population2 ✻ Item6	Datoga - USA ✻ Care_Stick - Author_Duties	-0.855	0.098	0.425	0.351	0.516	-8.706	< .001

Population3 ✻ Item6	Iraqw - USA ✻ Care_Stick - Author_Duties	-0.210	0.144	0.811	0.611	1.075	-1.457	0.145
Population1 ✻ Item7	Hadza - USA ✻ Care_Stone - Author_Duties	-0.681	0.097	0.506	0.418	0.612	-6.998	< .001
Population2 ✻ Item7	Datoga - USA ✻ Care_Stone - Author_Duties	-0.737	0.098	0.479	0.395	0.580	-7.543	< .001
Population3 ✻ Item7	Iraqw - USA ✻ Care_Stone - Author_Duties	-0.101	0.144	0.904	0.682	1.197	-0.706	0.480
Population1 ✻ Item8	Hadza - USA ✻ Fair_Cloth - Author_Duties	-0.486	0.098	0.615	0.507	0.746	-4.938	< .001
Population2 ✻ Item8	Datoga - USA ✻ Fair_Cloth - Author_Duties	-0.553	0.099	0.575	0.474	0.698	-5.593	< .001
Population3 ✻ Item8	Iraqw - USA ✻ Fair_Cloth - Author_Duties	-0.012	0.147	0.988	0.740	1.318	-0.084	0.933
Population1 ✻ Item9	Hadza - USA ✻ Fair_Food - Author_Duties	-0.344	0.101	0.709	0.582	0.864	-3.417	< .001
Population2 ✻ Item9	Datoga - USA ✻ Fair_Food - Author_Duties	-0.415	0.101	0.660	0.541	0.806	-4.093	< .001
Population3 ✻ Item9	Iraqw - USA ✻ Fair_Food - Author_Duties	0.013	0.153	1.013	0.750	1.369	0.087	0.931
Population1 ✻ Item10	Hadza - USA ✻ Fair_Lies - Author_Duties	-0.470	0.100	0.625	0.514	0.761	-4.687	< .001
Population2 ✻ Item10	Datoga - USA ✻ Fair_Lies - Author_Duties	-0.532	0.101	0.587	0.482	0.715	-5.285	< .001
Population3 ✻ Item10	Iraqw - USA ✻ Fair_Lies - Author_Duties	0.009	0.149	1.009	0.753	1.352	0.061	0.952
Population1 ✻ Item11	Hadza - USA ✻ Fair_Work - Author_Duties	-0.173	0.102	0.841	0.689	1.027	-1.695	0.090
Population2 ✻ Item11	Datoga - USA ✻ Fair_Work - Author_Duties	-0.257	0.103	0.773	0.632	0.946	-2.499	0.012
Population3 ✻ Item11	Iraqw - USA ✻ Fair_Work - Author_Duties	0.156	0.155	1.169	0.862	1.584	1.006	0.315
Population1 ✻ Item12	Hadza - USA ✻ Loyal_Family - Author_Duties	-0.561	0.100	0.570	0.469	0.694	-5.627	< .001

Population2 ✻ Item12	Datoga - USA ✻ Loyal_Family - Author_Duties	-0.663	0.101	0.516	0.423	0.628	-6.555	< .001
Population3 ✻ Item12	Iraqw - USA ✻ Loyal_Family - Author_Duties	-0.001	0.147	0.999	0.749	1.332	-0.007	0.994
Population1 ✻ Item13	Hadza - USA ✻ Loyal_Friend - Author_Duties	-0.506	0.100	0.603	0.496	0.734	-5.057	< .001
Population2 ✻ Item13	Datoga - USA ✻ Loyal_Friend - Author_Duties	-0.487	0.099	0.614	0.506	0.746	-4.929	< .001
Population3 ✻ Item13	Iraqw - USA ✻ Loyal_Friend - Author_Duties	-0.491	0.166	0.612	0.443	0.847	-2.963	0.003
Population1 ✻ Item14	Hadza - USA ✻ Loyal_Trade - Author_Duties	-0.594	0.101	0.552	0.453	0.673	-5.903	< .001
Population2 ✻ Item14	Datoga - USA ✻ Loyal_Trade - Author_Duties	-0.594	0.100	0.552	0.454	0.671	-5.951	< .001
Population3 ✻ Item14	Iraqw - USA ✻ Loyal_Trade - Author_Duties	-0.622	0.169	0.537	0.386	0.748	-3.681	< .001
Population1 ✻ Item15	Hadza - USA ✻ Loyal_Tribe - Author_Duties	-0.504	0.100	0.604	0.497	0.735	-5.031	< .001
Population2 ✻ Item15	Datoga - USA ✻ Loyal_Tribe - Author_Duties	-0.655	0.103	0.520	0.425	0.635	-6.387	< .001
Population3 ✻ Item15	Iraqw - USA ✻ Loyal_Tribe - Author_Duties	0.140	0.145	1.150	0.865	1.527	0.963	0.336
Population1 ✻ Item16	Hadza - USA ✻ Purity_Freq - Author_Duties	-0.213	0.093	0.808	0.674	0.969	-2.302	0.021
Population2 ✻ Item16	Datoga - USA ✻ Purity_Freq - Author_Duties	-0.182	0.091	0.834	0.697	0.998	-1.986	0.047
Population3 ✻ Item16	Iraqw - USA ✻ Purity_Freq - Author_Duties	0.214	0.140	1.239	0.942	1.630	1.532	0.125
Population1 ✻ Item17	Hadza - USA ✻ Purity_Granny - Author_Duties	-0.352	0.090	0.704	0.590	0.839	-3.927	< .001
Population2 ✻ Item17	Datoga - USA ✻ Purity_Granny - Author_Duties	-0.320	0.088	0.726	0.610	0.863	-3.622	< .001
Population3 ✻ Item17	Iraqw - USA ✻ Purity_Granny - Author_Duties	-0.076	0.139	0.927	0.705	1.218	-0.546	0.585

Population1 ✻ Item18	Hadza - USA ✻ Purity_Marry - Author_Duties	-0.508	0.090	0.602	0.505	0.717	-5.672	< .001
Population2 ✻ Item18	Datoga - USA ✻ Purity_Marry - Author_Duties	-0.566	0.090	0.568	0.476	0.677	-6.312	< .001
Population3 ✻ Item18	Iraqw - USA ✻ Purity_Marry - Author_Duties	0.018	0.135	1.018	0.782	1.326	0.132	0.895
Population1 ✻ Item19	Hadza - USA ✻ Purity_Stranger - Author_Duties	-0.094	0.095	0.910	0.756	1.095	-0.997	0.319
Population2 ✻ Item19	Datoga - USA ✻ Purity_Stranger - Author_Duties	-0.042	0.093	0.959	0.799	1.151	-0.453	0.651
Population3 ✻ Item19	Iraqw - USA ✻ Purity_Stranger - Author_Duties	0.046	0.150	1.047	0.781	1.404	0.308	0.758