

Quantifying the Distance between Religions: A Survey Based, Data Driven Approach

Pavithran Thilakanathan, Rezza Moeini, Mary Legrand

Cultural Infusion Pty Ltd., Melbourne, Australia

Email: pavithranthilakanathan@gmail.com, Rezza.Moeini@culturalinfusion.com, Mary.Legrand@culturalinfusion.com

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Abstract

Religion has long been recognised as a central dimension of culture, yet no dedicated framework exists to quantify the cultural distance between religions. Existing models, such as Hofstede's Cultural Dimensions, the GLOBE study, and Inglehart and Welzel's cultural map, primarily focus on cross-national differences and treat religion as a single categorical variable. This study introduces a novel quantitative methodology for measuring cultural distance between religions by adapting the Cultural Fixation Index (CF_{ST}), originally derived from population genetics to cultural and behavioural survey data. Using data from the seven waves of the World Values Survey (1981-2022), religious groups were compared across selected value dimensions corresponding to Traditional versus Secular-Rational and Survival versus Self-Expression values. Responses were normalised, grouped by religion, and analysed to produce pairwise CF_{ST} values and a composite distance matrix representing inter-religious variation. The methodology accounts for both between-group and within-group variance, ensuring that intra-religious diversity is preserved in the calculation. The results demonstrate that the CF_{ST} approach can identify statistically meaningful distinctions between religions based on belief, practice, and value orientations. This provides a replicable and data-driven framework for quantifying religious and cultural differences, enabling future research in comparative religion, cultural evolution, and cross-cultural psychology.

Keywords

Cultural Fixation Index (CF_{ST}), World Values Survey (WVS), Large Language Model (LLM), Heterozygosity, Cultural Distance, Hofstede's Cultural Dimensions, Distance Matrix

1. Introduction

Religion has been an important aspect of social science and yet a clear understand-

ing of what differentiates one religion from another and by what characteristics has not yet been established. Many existing frameworks focus on the qualitative differences between religions or are mainly designed to measure the difference between cultures as a whole or cultural differences between countries. In all these frameworks covered extensively in the literature, religion is included as a single component or variable in the calculation. A dedicated framework or methodology does not exist for the purpose of determining a quantifiable distance between religions themselves.

Although works like Ninian Smart's "Religious Experience of Mankind" (Smart, 1969), Hofstede (1984) and the GLOBE project (House et al., 2004) have attempted to fit cultures into a set of dimensions or characteristics, they do not serve as a methodology for clearly distinguishing between religions. One particular methodology that does however suit the calculation of distance between religions is the **Cultural Fixation Index** (CF_{ST}) developed by Muthukrishna et al. (Muthukrishna et al., 2020). The CF_{ST} can be directly applied to the preprocessed World Values Survey (WVS) (Haerpfer et al., 2022) data on religions to calculate the distance between them.

This study aims to develop a methodology to quantify the cultural differences between religions and attempt to answer the question of whether these differences are significant enough for there to be a clear distinction between them. The WVS data from 7 waves from 1981 to 2022 will be preprocessed and manipulated to prepare for distance calculation. A set of questions will be selected based on Inglehart and Welzel's cultural map where they will fall under the categories, **Traditional versus Secular-Rational** and **Survival versus Self-Expression** values. The CF_{ST} will be calculated for each question for each respondent pairwise and these pairwise distance measures will be used to develop a composite distance matrix representing the distances between each religion in the dataset. This Methodology ensures that within group (religion) variance between each respondent is also considered when calculating the difference between each religion.

2. Problem Statement

Although religion is an important aspect of social science, a dedicated framework for quantifying the cultural distance between religious groups does not exist (Dow & Karunaratna, 2006). Existing models either consider religion as a single component within a broader cultural landscape or focus on the qualitative distinctions which overlap and are shared among many religions. This does not provide a clear and measurable methodology for distinguishing between the intrinsic characteristics of these religions. Not having a clear understanding of these distinctions leads to many misconceptions about how different or similar many religions really are.

3. Literature Review

In an effort to quantify the cultural differences between religions, researchers have

historically relied on broad dimensional models such as Hofstede's cultural dimensions (Hofstede, 1984), the GLOBE project (House et al., 2004) and Inglehart and Welzel's cultural map (Inglehart & Welzel, 2005). In research published in our papers in 2017 (Moieni et al., 2017) and 2022 (Moieni & Mousaferiadi, 2022), which were aimed at measuring diversity; ethnicity (country of birth), linguistics, and worldviews (beliefs) were defined as the main elements of cultural diversity. Furthermore, the four pillars of culture were defined as country of birth, ethnicity, language, and religion and they defined diversity from three different aspects, namely, variety, balance and disparity. The methodology devised by the authors used the theory of entropy to measure variety and balance. However, it did not provide a methodology to measure distinctions in terms of ethnolinguistics and religious identities. Further studies in the realm of cultural diversity produced a methodology (Moieni et al., 2023) adopting Grey Models and Auto-regressive Integrated Moving Averages (ARIMA) (Box et al., 2015) algorithm and small data to predict linguistic or religious diversity in a cohort, which was later improved in 2024 (Rios et al., 2024). This method, however, does not serve as a statistical solution to when divergence or convergence occurs in religion or linguistics in a particular cohort.

3.1. Fixation Index (F_{ST})

In the field of population genetics, a method called the Fixation Index (F_{ST}) was developed to measure the genetic differences between subpopulations (Wright, 1949). The F_{ST} calculates the proportion of total variance that can influence the between group variance in relation to within group variances. The main function of the method is to determine whether there is a significant difference between groups by considering the intra-group variance.

This same idea from population genetics was later adapted into the domain of cultural dimensions by Muthukrishna et al. (2020), which was introduced as the Cultural Fixation Index (CF_{ST}). The same principal is applied to survey and behavioral data, which provides a way to find the cultural distance across different populations while accounting for the full distribution of responses and their variance. Unlike previous work on cultural distance measures (Kogut & Singh, 1988), the CF_{ST} avoids relying on dimension weighted averages and instead captures the distribution of variances across multiple variables.

3.2. Applying the Cultural Fixation Index (CF_{ST})

The application of CF_{ST} to the World Values Survey (WVS) presents a novel approach for measuring the distance between religions. Previous work related to this domain has made use of the WVS data to map cultural values (Inglehart & Welzel, 2005) or to supplement Hofstede's dimensions by expanding on the theoretical aspect (Hofstede, 1984). These methods however have been applied in other contexts such as finding the cultural differences between countries where religion is a single variable that contributes to the distinction rather than being the primary

unit of analysis. Instead by grouping the respondents by their religion and applying the CF_{ST} to the responses, it becomes possible to directly quantify the degree of differentiation between the religions based on the respondents' beliefs, values and practices.

In the context of cross-cultural and international business, there have been application of approaches such as Jaccard similarity coefficients, Euclidean distance, and psychic distance (Dow & Karunaratna, 2006). The problem with these approaches is that they either reduce cultural differences to aggregated scores or treat religion as a categorical label. Doing so ignores the internal heterogeneity of religious groups which provide valuable information on their distinctions. The CF_{ST} , by contrast, explicitly incorporates both between-group and within-group variance, which makes it a more detailed approach to determining the differences between religions.

3.3. Quantitative Approaches in the Study of Religion

Apart from cultural frameworks, several large-scale projects have attempted to systematically compare and document the different aspects of religion. The Database of Religious History (DRH) (Slingerland & Monroe, 2024) aggregates coded information compiled by experts on religious practices and traditions across history. The World Religion Database (WRD) (Zurlo, 2025) is another example which provides demographic estimates of religious adherence worldwide, and using a survey-based approach, Pew Research Centre has conducted global surveys on religious practices and beliefs on a large scale (Pew Research Centre, 2017).

While these projects are providing valuable data and insight, they primarily serve as a descriptive repository. They do not provide a statistical framework and are also difficult to translate into a format which may allow a reliable distinction between religions to be made. This is because of the constraint placed upon them through expert codings or census-based self-identification which in most cases fails to capture the variance that exists in lived religious practices and beliefs.

In contrast to this, the WVS captures individual-level data on beliefs and values which makes it suitable for applying the CF_{ST} , which is based on within group variance. Hence, while databases such as DRH and WRD contextualise the study of religion, they fail to be a substitute for a quantitative measure of religious distance.

3.4. Alternative Statistical Distance Measures in Social Science

Numerous distance measures have been used in cross-cultural research, though few have been proven to be well suited for the problem of religious distance comparison.

- A distance measure called the **Psychic Distance** (Dow & Karunaratna, 2006) incorporates religion alongside language, education, and political systems for the purpose of explaining international business. In this case a set of psychic distance stimuli are tested which include religion, culture, language, education and political systems.

- The **Culture Consensus Theory** (Romney et al., 1986) is another example that provides a framework for identifying shared beliefs within groups. However, this does not include the between group comparisons and was not designed as a measurement of distance between cultures.

Multidimensional scaling (MDS) and **cluster analysis** have been used for visualising cultural differences. Borgatti et al., for example, have used such techniques as MDS in their work for the use of social network analysis (SNA) in social sciences (Borgatti et al., 2009).

3.5. A Quantitative Approach for Religious Distance Calculation

Previous attempts to quantify the comparison between religions have either relied on descriptive, expert made religious databases such as DRH, WRD, broad cultural definitions such as Hofstede, GLOBE and Inglehart’s cultural map or simple distance metrics such as Euclidean, Jaccard and psychic distance. None have been able to provide a specific method for quantifying the distance between religions as distinct yet internally diverse groups. By applying the cultural fixation index on the responses from aggregated WVS data, this study introduces a methodology that addresses the missing function for this calculation. The methodology offers a way to measure religious distance that is data-driven, variance-sensitive and replicable to other contexts such as cultural comparison among religions and across demographics of respondents. **Table 1** shows a comparison of other methodologies, their core principle and other factors.

Table 1. Summary comparison table of research methods.

Methodology	Core Principle	Disciplinary Origin	Unit of Analysis	Primary Data Sources	Definition / Metric of Distance	Key Proponent and Citations
Cultural Fixation Index (CF _{ST})	Cultural distance is the statistical variance in values, beliefs, and behaviours between populations.	Population Genetics, Cultural Evolution	Individual, Cultural Group	World Values Survey (WVS)	Statistical variance of survey responses	M. Muthukrishna, J. Henrich, A. Norenzayan (Muthukrishna et al., 2020)
Dow’s Religious Distance Scale	Religious distance is a function of a pre-defined hierarchical classification and demographic overlap.	International Business, Sociology	Country	National statistics, Encyclopedias of religion	Composite factor score based on hierarchical classification (R1) and population incidence (R2, R3)	D. Dow (Dow, 2015)
Phylogenetic Analysis	Religions evolve via “descent with modification”; distance is historical separation from a common ancestor.	Evolutionary Biology, Linguistics	Religious Group, Society	Ethnographic databases, historical records, linguistic trees	Cladistic branching and time since divergence on a phylogenetic tree	J. Watts, R. Mace, P. Turchin (Basava et al., 2021)
NLP-based Textual Analysis	Distance is the semantic, thematic, or stylistic divergence between sacred texts treated as data corpora.	Computational Linguistics, Digital Humanities	Word, Sentence, Text (Corpus)	Digitized sacred texts (Bible, Quran, etc.)	Semantic vector distance (e.g., Cosine Similarity, FID), topic distribution divergence	W. van Peursen, H. McGovern (Sane et al., 2025)

4. Methodology

This section describes in detail the methodology devised from the research starting from constructing the theoretical dimensions for religions up to evaluation of the results.

4.1. Data Source

The raw WVS data is available for download from the WVS website (Inglehart et al., 2022). The survey is conducted in waves from the year 1981 from wave 1 to 7 comprising of 443,488 responses. The dataset used for this project is the aggregated dataset comprised of responses from all waves from 1981 to 2022. The WVS provides standardized survey questions which cover values, beliefs, and social attitudes, along with the primary variable the religious affiliation of the respondent. The survey does not however, cover every single religious denomination and contains an imbalance in the number of responses. The imbalance is due to some major religions such as Islam and Buddhism containing larger number of respondents while other, lesser-known denominations contain less responses. This imbalance is addressed by using only 50 responses for each religion and removing religions which contain an insignificant number of responses (less than 50 responses).

Sample from the dataset (pre-processed not normalised) shown in Table 2. This dataset does not contain all columns for brevity:

Table 2. Pre-processed sample dataset.

A001	A002	A003	A004	A005	A006	F063	Religion
0	1	2	2	4	2	2	Shia
1	1	2	2	3	2	2	Sikhism
2	1	2	2	4	1	1	Buddhist
3	1	2	2	3	2	2	Church of Sweden
4	1	2	2	4	1	1	Islam

4.2. Operationalisation of Religious Dimensions

Religions are complex entities that encompass theology, ritual practice, ethics and social organisation. For quantitative comparison, these dimensions were operationalised into value dimensions by using survey items from the WVS. Selection of the appropriate variables was guided mainly by two principles:

- **Theoretical Relevance**—Questions had to map onto recognized axes of cultural and religious difference, such as Inglehart & Welzel's (2005) Traditional vs Secular-Rational and Survival vs Self-Expression dimensions.
- Questions provided insight into distinguishable dimensions of religion.

Questions fall into dimensions including:

- Metaphysics
- Cosmology

- Anthropology
- Soteriology
- Ethics & Morality
- Praxis
- Epistemology
- Ecclesiology
- Eschatology
- Exclusivity

4.3. Data Preprocessing and Preparation

Preprocessing required many steps to remove and manipulate the responses to be suitable for the CF_{ST} formula. Several questions had different Likert scales, and some questions had binary scales. These scales were converted into normalized categorical scales. Once the scales were standardized and were comparable with binary scales, the values were then normalized using min-max scaling to the [0, 1] interval which prevents distortion from scale differences between questions. Answers such as “Don’t know” or “No Answer” were replaced with 0 so as not to affect the calculation. The code for each religion was acquired from the WVS code book and used to match against the religion code in the dataset for each respondent. The respondents were then grouped by Religion and to avoid the imbalance found in respondent count for each religion, only the 50 responses were selected for each religion and any with lesser responses were removed. A sample from this dataset is shown in **Table 3**.

Table 3. Sample data preprocessed and scaled.

A001	A002	A003	A004	A005	A006	F063	Religion
0.5	0.0	0.25	0.75	0.3	0.25	0.25	Shia
0.25	1	0.5	0.25	0.5	0.33	0.25	Sikhism
0.25	1	0.5	0.5	0.25	0.7	0.3	Pentecostal
0.25	0.25	0.5	0.33	0.25	0.5	0.5	Catholic
1	1	0.25	0.5	0.5	0.25	0.25	Hinduism

4.4. Cultural Fixation Index (CF_{ST})

The primary formula that acts as the distance calculator for religions is the CF_{ST} (Muthukrishna et al., 2020). The calculation is performed in multiple steps, resulting in a **dimensional CF_{ST} summary** which shows CF_{ST} values for each religion across each dimension, a **dimensional matrix** for each pair of religions showing how different they are across each dimension, and a **composite distance matrix** showing the final distance matrix for all religions.

The CF_{ST} is defined as:

$$CF_{ST} = \frac{H_t - H_g}{H_t} \quad (1)$$

Equation (1): Cultural Fixation Index (CF_{ST})

Where H_T is the total heterozygosity (variance across the full sample) and H_s is the average within-group heterozygosity (within-group variance).

Example calculation for distance between **African Traditional Religions** and **Hinduism** for the question **F001** (how often the respondents think about the meaning of life):

Step 1: Extract responses

For further illustration of the CF_{ST} calculation, consider the question F001 from the WVS dataset which is from the **Metaphysics** dimension. The scaled responses from respondents of each religion will be isolated. The relative frequencies of scaled responses of each religion are shown below in **Table 4**.

Table 4. Example responses for question F001.

Religion	0.00	0.25	0.50	1
African Traditional Religions	0.26	0.26	0.36	0.97
Hinduism	0.26	0.26	0.36	0.87

Step 2: Compute total heterozygosity (H_T)

The diversity of all responses pooled across both religions is represented by the total heterozygosity.

In the case of a binary or continuous normalized variable, the overall mean is first computed:

p_T = mean of all F001 values across both groups

If $p_T = 0.70$, then

$$H_T = 2 \times p_T \times (1 - p_T) = 2 \times 0.70 \times 0.30 = 0.42 \tag{2}$$

Equation (2): Compute total heterozygosity (H_T)

Step 3: Compute within-group heterozygosity (HS)

The mean response within each religion is then calculated as shown in **Table 5**.

Table 5. Mean response within each religion.

Religion	Mean (F001)	Heterozygosity $H_g = 2p_g(1 - p_g)$
African traditional religions	0.88	$2 \times 0.88 \times 0.12 = 0.21$
Hinduism	0.48	$2 \times 0.48 \times 0.52 = 0.50$

Then the average across groups is calculated as shown in Equation (3):

$$H_s = \frac{0.21 + 0.50}{2} = 0.355 \tag{3}$$

Equation (3): Within-group heterozygosity

Step 4: Compute CF_{ST}

Now using H_T and H_s we can calculate CF_{ST} which measures the proportion of total diversity that exists between the religions rather than within the religions as shown in Equation (4).

$$CF_{ST} = \frac{H_t - H_s}{H_t} = \frac{0.42 - 0.355}{0.42} = 0.155 \quad (4)$$

Equation (4): Computing final CF_{ST}

Step 5: Interpretation

The computed CF_{ST} value of 0.155 shows a modest difference between Hinduism and African Traditional Religions based on the responses from the WVS. The values produced will be between 0 and 1 and values that are closer to 0 show little difference while values closer to 1 show more variance between each group pair. This difference is for the question F001 only and is an example of how the overall calculation is done. This would be averaged across all the selected questions from the WVS for each religion pair and the distance matrix will be created accordingly.

Adaptation for Religious Dataset

To adapt the CF_{ST} to the WVS data, each response was treated as a categorical or binary marker of cultural traits. The pairwise distances for each pair of religions were computed using response similarity across individuals. For each survey item:

- For each religious group, pairwise differences were computed within and between religious groups.
- The CF_{ST} was calculated for each item.
- The CF_{ST} for each religion for each dimension was calculated creating a dimension-level matrix for each religion.
- Item-level CF_{ST} values were aggregated into composite CF_{ST} distance matrix which represents the distances between each pair of religions.

Each of these procedures is to ensure that the differences between religions are assessed not only in terms of the group averages but also in terms of the distributional spread of all responses as shown in **Figure 1** and the network diagram in **Figure 2**. **Table 6** shows the resulting distance matrix.

Table 6. Distance matrix values for selected comparisons.

	African traditional religions	Anglican	Baptist	Buddhist	Catholic	Islam	Hinduism	Chinese traditional religion	Church of Sweden
African traditional religions	0.00%	10.30%	7.88%	5.02%	3.13%	8.08%	8.57%	3.55%	12.70%
Anglican	10.30%	0.00%	5.13%	6.00%	5.58%	5.08%	3.71%	11.14%	5.86%
Baptist	7.88%	5.13%	0.00%	2.82%	4.16%	2.06%	4.04%	10.48%	7.76%
Buddhist	5.02%	6.00%	2.82%	0.00%	3.01%	3.62%	4.97%	6.26%	7.62%
Catholic	3.13%	5.58%	4.16%	3.01%	0.00%	3.97%	4.46%	4.52%	7.59%
Islam	8.08%	5.08%	2.06%	3.62%	3.97%	0.00%	3.65%	10.31%	7.92%
Hinduism	8.57%	3.71%	4.04%	4.97%	4.46%	3.65%	0.00%	10.47%	7.49%
Chinese traditional religion	3.55%	11.14%	10.48%	6.26%	4.52%	10.31%	10.47%	0.00%	13.28%
Church of Sweden	12.70%	5.86%	7.76%	7.62%	7.59%	7.92%	7.49%		

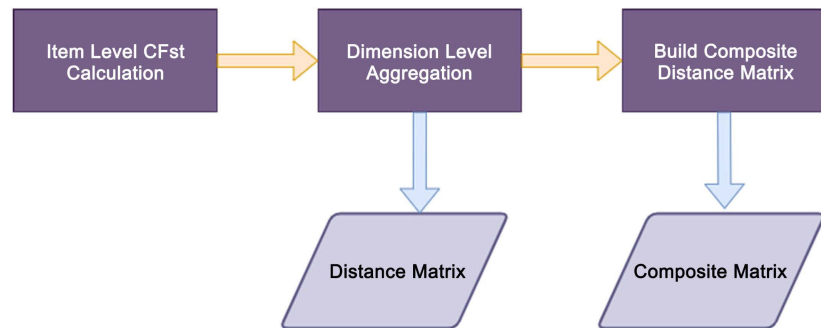


Figure 1. CF_{ST} methodology.

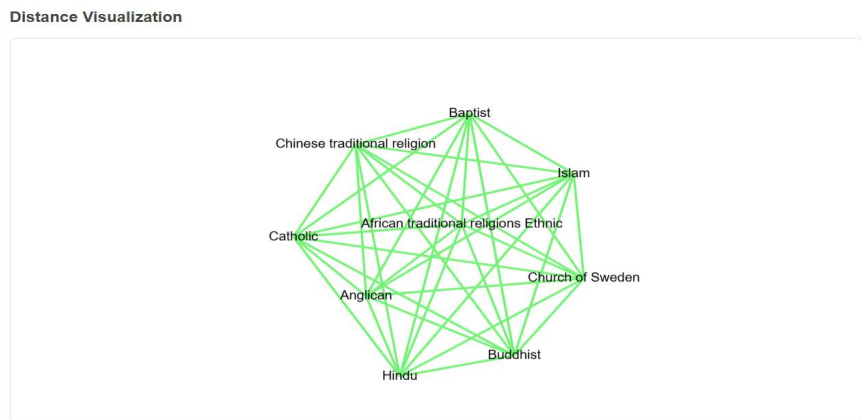


Figure 2. Network diagram visualisation of distances.

5. Results and Discussion

5.1. Overview of Dataset and Religions

The variance between religions is a complex metric to identify and quantify. This research has strictly stayed close to survey data and variance between responses in terms of religious belief and practices to identify this metric. The main limitation of this methodology proved to be the imbalance of the religions or religious denominations that respondents claimed to belong to which is shown in **Figure 3**.

To mitigate this imbalance the total number of responses was brought down to 50 for each religion which significantly reduced the variability at the same time. However, respondents were chosen based on the quality of the responses, for example, it was ensured that respondents who left out answers to a lot of questions or answered “Don’t know” to most were excluded. The reduced and scaled dataset contained N = 3048 responses with 50 responses for each religion.

5.2. Pairwise Cultural Distances between Religions

Pairwise CF_{ST} values were computed between all religions based on normalized responses to WVS items. The resulting composite distance matrix quantifies the degree of cultural differentiation, where higher values indicate greater divergence in value structures which can be interpreted from the CF_{ST} values in the heatmap in **Figure 4**.

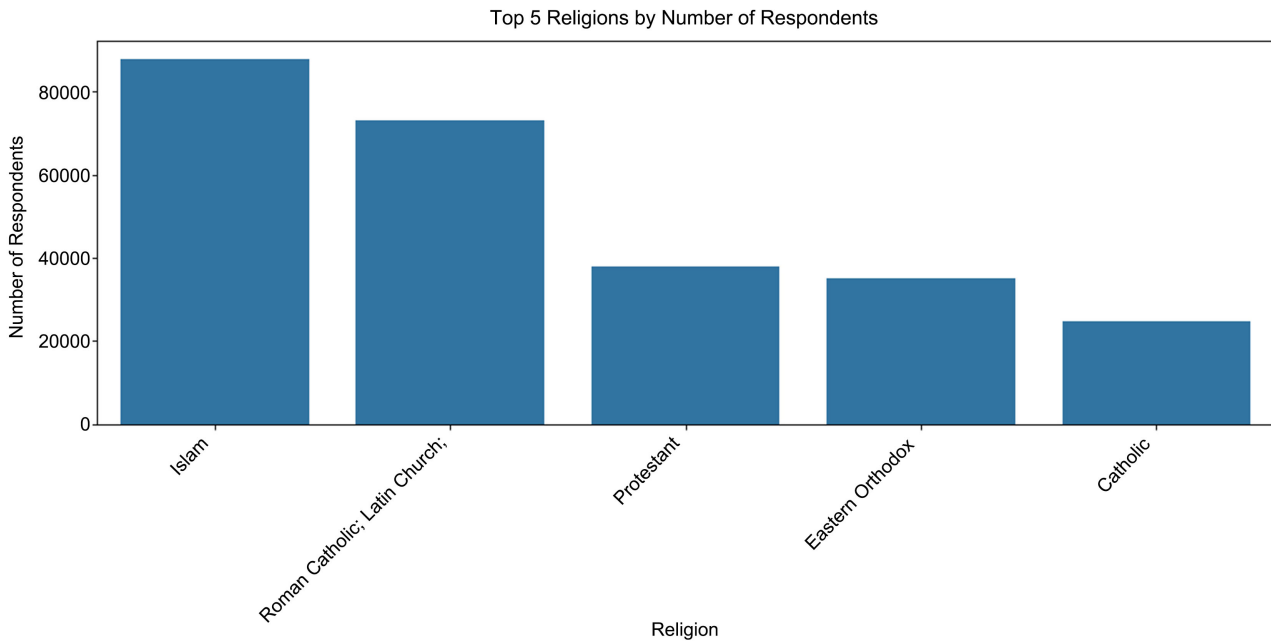


Figure 3. Top 5 religions by number of respondents.

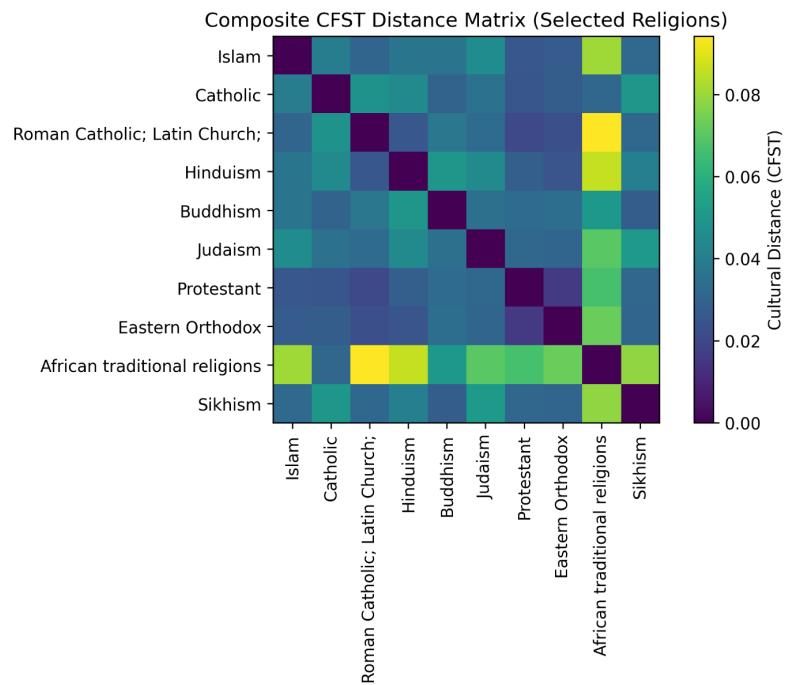


Figure 4. Heatmap for composite CF_{ST} Distance Matrix (10 Religions).

The results shown in **Figure 5** reveal clear clustering patterns: Abrahamic Religions (Islam, Catholicism, Protestantism, Judaism) exhibit relatively low pairwise distances ($CF_{ST} = 0.05 - 0.12$), suggesting broadly aligned value orientations. In contrast, non-Abrahamic religions such as Hinduism and Buddhism show comparatively higher distances from these groups ($CF_{ST} = 0.18 - 0.27$), indicating stronger differentiation in their moral and belief outlooks.

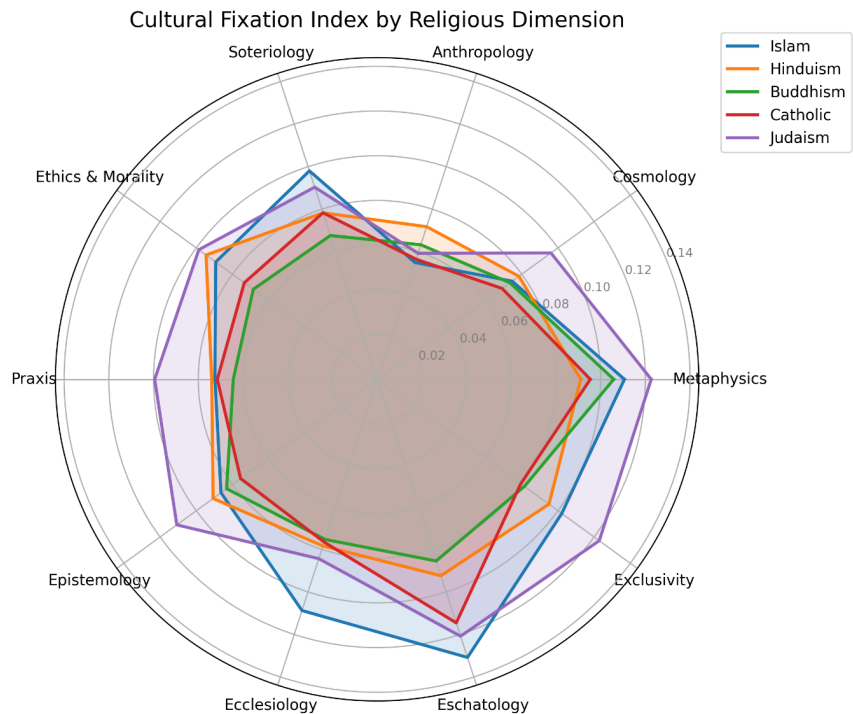


Figure 5. Dimensional CF_{ST} radar chart.

5.3. Dimensional Differentiation

To explore the cultural differences that exist between religions from a deeper perspective, across distinct domains of beliefs, the CF_{ST} was computed for each predefined dimension which are Metaphysics, Cosmology, Ethics, Ecclesiology, Epistemology, Eschatology, Ethics & Morality, Exclusivity, Praxis, and Soteriology. A set of WVS questions was aggregated across each dimension that were conceptually associated with them. The mean score averaged per religion for each dimension was used to generate the radar chart shown in **Figure 5** for 5 major religions.

Higher CF_{ST} scores indicate a stronger differentiation in that dimension and lower CF_{ST} shows greater overlap or shared orientation with other groups. Among the 10 analysed, metaphysics, eschatology and exclusivity showed the highest CF_{ST} values across most major religions which suggests that these dimensions serve as key boundaries of doctrinal and conceptual distinctiveness. Metaphysical differentiation primarily reflects divergent understandings of reality, divinity and existence, while eschatological and exclusive dimensions capture contrasting beliefs regarding salvation, afterlife and religious identity.

Each axis in the radar chart (**Figure 5**) represents a cultural domain, and the radial distance from the center corresponds to the CF_{ST} score for that religion. The figure reveals profiles of religious differentiation that are structurally distinct. **Islam** extends strongly on Eschatology and Ecclesiology, which shows the religion's emphasis on structured theology and community organisation. **Catholicism** shows similar peaks in Cosmology and Eschatology, which aligns with its doctrinal emphasis on the afterlife and divine order. **Buddhism** extends further along

Metaphysics reflecting the unique ontological orientations.

5.4. Limitations and Future Work

Several limitations warrant caution in this research, some of which are related to the dataset, have been discussed. Although the WVS dataset contains a large number of responses, there is an imbalance of responses belonging to religions. As shown in **Figure 4**, certain major religions, such as Islam had a significantly larger proportion of responses compared to certain lesser-known denominations, which is to be expected given the difference in popularity of certain religions over others. More data will not necessarily solve this limitation. However, future waves of the survey may present a solution to this hurdle by covering a larger sample from each religion. Another limitation would be that the WVS captures self-reported attitudes rather than doctrinal theology, which means that the differences that can be observed in the data reflect the lived cultural expressions of individuals rather than textual orthodoxy.

More accurate future CF_{ST} calculations will be possible with the use of future WVS waves, as the sample size and diversity in the samples have increased over time. With a more diverse dataset, the CF_{ST} values will not weigh more on the within-group variance of the religions that have more responses and reflect the actual distinctions in values. Since the number of responses does not need to be reduced, with more responses, more accurate CF_{ST} values can be produced. Further research can also explore the use of Large Language Models (LLMs) for the purpose of processing large corpora of religious scriptures, texts and scholarly work to extract distinguishing factors that may not be available through survey data. Furthermore, an accurate genealogical tree can be constructed through careful investigation of genealogical roots of religions and denominations to build a hierarchical family tree of religions, which may then be used to add a layer of complexity to the distance calculations through tree distance algorithms.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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