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Machine Learning-Based Identification of Cultural Determinants of Decision-Making: The Role of Risk Perception, Uncertainty Avoidance, and Norm Compliance

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A B S T R A C T

Objective: The present study aimed to identify and model the cultural determinants of decision-making using machine learning techniques, with a specific focus on the predictive roles of risk perception, uncertainty avoidance, and norm compliance.

Methods and Materials: This study employed a descriptive–correlational design with a machine learning predictive framework. The sample consisted of 412 adult participants from Portugal selected through stratified random sampling to ensure demographic diversity. Data were collected using standardized instruments measuring risk perception, uncertainty avoidance, norm compliance, and decision-making quality. After preprocessing procedures including normalization and handling of missing values, data were analyzed using both traditional statistical methods and advanced machine learning algorithms. Supervised learning models, including Logistic Regression, Support Vector Machine, Random Forest, and Gradient Boosting, were applied to predict decision-making outcomes. Model performance was evaluated using k-fold cross-validation and metrics such as accuracy, precision, recall, F1-score, and area under the ROC curve. Feature importance analysis was conducted to determine the relative contribution of predictors.

Findings: The results indicated that all three cultural variables significantly predicted decision-making quality, with norm compliance emerging as the strongest predictor, followed by risk perception and uncertainty avoidance. Ensemble models demonstrated superior predictive performance, with Gradient Boosting achieving the highest accuracy and classification efficiency compared to other models. Feature importance analysis confirmed the dominant role of norm compliance in influencing decision-making outcomes. Additionally, significant positive relationships were observed among all study variables, indicating that higher levels of cultural alignment correspond to improved decision-making quality.

Conclusion: The findings highlight the critical role of cultural determinants in shaping decision-making processes and demonstrate the effectiveness of machine learning approaches in modeling complex behavioral patterns. Integrating cultural variables into predictive frameworks enhances both theoretical understanding and practical applications of decision-making research.

Keywords: *Decision-Making; Machine Learning; Risk Perception; Uncertainty Avoidance; Norm Compliance; Cultural Determinants*

1 Introduction

Decision-making is a fundamental psychological and behavioral process that underpins individual and collective actions across social, economic, and organizational domains. In recent decades, scholars have increasingly emphasized that decision-making cannot be fully understood without considering the cultural contexts in which it is embedded. Cultural determinants shape how individuals perceive risks, tolerate uncertainty, and adhere to social norms, thereby influencing both the cognitive and behavioral dimensions of decision-making processes. Contemporary research highlights that cultural frameworks operate as implicit schemas guiding perception, evaluation, and action, particularly in complex and ambiguous environments (Gupta & Gupta, 2025; Omrane & Khan, 2024). These frameworks are not static; rather, they evolve through institutional, technological, and social transformations, which in turn necessitate more sophisticated analytical approaches capable of capturing dynamic interactions among cultural variables.

One of the most critical constructs in understanding culturally influenced decision-making is risk perception. Risk perception reflects individuals' subjective evaluation of the likelihood and severity of potential negative outcomes, and it is strongly shaped by cultural narratives, social learning, and prior experiences. Empirical evidence suggests that individuals from different cultural backgrounds exhibit systematically different risk profiles, which influence their decision strategies in domains ranging from finance to health behavior (Harris et al., 2022; Hinsberg et al., 2024). For example, risk perception is often amplified or attenuated by trust in institutions, communication structures, and social expectations, particularly in crisis situations where uncertainty is high (Song & Mbah, 2024; Turcanu et al., 2020). Moreover, recent studies indicate that risk perception is not only a cognitive assessment but also a socially constructed phenomenon influenced by descriptive norms and behavioral visibility (Zhang et al., 2022). These findings underscore the importance of integrating cultural and social variables into models of decision-making.

Closely related to risk perception is the concept of uncertainty avoidance, a cultural dimension that captures the extent to which individuals feel threatened by ambiguous or unknown situations. High uncertainty avoidance cultures tend to favor structured environments, formal rules, and predictable outcomes, whereas low uncertainty avoidance cultures are more tolerant of ambiguity and experimentation (Nair et al., 2022; Omrane & Khan, 2024). This dimension has been shown to influence a wide range of behaviors, including information-seeking, compliance, and innovation adoption. For instance, individuals with high uncertainty avoidance are more likely to rely on authoritative guidance and exhibit conservative decision-making patterns, particularly in contexts involving health risks or technological change (Chen et al., 2023; Li et al., 2025). Additionally, uncertainty avoidance interacts with trust and institutional frameworks to shape behavioral responses in both individual and organizational settings (Ibrahim et al., 2024; Yildirim-Öktem et al., 2023). Understanding this construct is therefore essential for explaining variability in decision-making across cultural contexts.

Norm compliance represents another pivotal cultural determinant of decision-making. It refers to the extent to which individuals align their behavior with perceived social expectations, moral standards, and institutional rules. Norm compliance is deeply rooted in socialization processes and reinforced through mechanisms such as social proof, moral obligation, and legal enforcement (Roy, 2021; Teichmann & Wittmann, 2022). Research indicates that individuals often rely on descriptive and injunctive norms as heuristics for decision-making, especially in situations characterized by uncertainty or limited information (Peng & Kim, 2020; Yao et al., 2024). Furthermore, norm compliance is influenced by cultural tightness–looseness, religiosity, and institutional quality, which together determine the strength and consistency of normative pressures (Othman et al., 2023; Sutrisno & Dularif, 2020). In organizational contexts, adherence to norms has been linked to governance structures, ethical behavior, and performance outcomes, highlighting its broader relevance beyond individual

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decision-making (Ahmad & Muslim, 2024; Saleh et al., 2025).

The interplay between risk perception, uncertainty avoidance, and norm compliance becomes particularly salient in contemporary environments characterized by rapid technological advancement and increasing complexity. Digital platforms, global supply chains, and cross-cultural interactions have created new contexts in which traditional decision-making models may no longer suffice. For example, cultural differences significantly influence how individuals interpret information, engage in social commerce, and respond to institutional signals (Chen et al., 2023; Cooper, 2024). Similarly, globalized business environments require decision-makers to navigate diverse cultural expectations, which can affect supplier relationships, procurement strategies, and organizational performance (Grant, 2024; Holloway, 2024). These developments highlight the need for integrative frameworks that can account for multiple cultural determinants simultaneously.

In this regard, machine learning offers a powerful methodological approach for advancing the study of culturally influenced decision-making. Unlike traditional statistical methods, machine learning algorithms can capture complex, nonlinear relationships and interactions among variables, enabling more accurate prediction and deeper insight into underlying patterns. Recent research has demonstrated the applicability of machine learning in domains such as automated decision systems, behavioral prediction, and cultural analytics (Manas, 2025; Rasaei, 2025). By leveraging large datasets and advanced computational techniques, machine learning models can identify latent structures and classify behavioral profiles with high precision. This capability is particularly valuable for examining how multiple cultural factors jointly influence decision-making outcomes.

Moreover, the integration of machine learning with psychological and cultural theories facilitates a more comprehensive understanding of human behavior. For instance, predictive models can incorporate variables such as trust, institutional context, and social expectations, which are known to mediate the relationship between cultural determinants and decision-making (Ferreras et al., 2024; Utami & Barokah, 2024). In addition, machine learning approaches can accommodate cross-cultural variability by identifying patterns that may not be evident through conventional analytical techniques. This is especially important in light of evidence suggesting that cultural effects are often context-dependent and moderated by environmental and situational factors (Yildirim-Öktem et al., 2023; Zhuang & Carey, 2024). Consequently, the application of machine learning represents a significant advancement in the methodological toolkit available to researchers in this field.

Another critical dimension of contemporary decision-making research is the role of information processing and avoidance. Individuals do not always seek or utilize information in a rational manner; instead, their behavior is influenced by cognitive biases, emotional responses, and social pressures. Studies have shown that individuals may actively avoid information that is perceived as threatening or inconsistent with their beliefs, particularly in high-risk contexts such as health crises (Link, 2021). This phenomenon interacts with cultural determinants, as norms and uncertainty avoidance can either encourage or discourage information engagement. Additionally, conformity behavior plays a significant role in shaping decision-making during crises, where individuals often rely on the actions of others as a guide (Yao et al., 2024). These insights further emphasize the need to consider multiple interacting factors in the analysis of decision-making processes.

From an institutional perspective, cultural determinants also influence governance, compliance, and ethical behavior. Organizations operating in diverse cultural environments must navigate varying expectations regarding transparency, accountability, and social responsibility. Research indicates that internal control systems, corporate governance structures, and institutional frameworks are shaped by cultural values, which in turn affect decision-making at the organizational level (Ahmad & Muslim, 2024; Saleh et al., 2025). Furthermore, the relationship between formal and informal institutions plays a crucial role in determining behavioral outcomes, particularly in areas such as environmental performance and financial decision-making (Ferreras et al., 2024). These findings highlight the broader implications of cultural determinants beyond individual-level analysis.

In addition to organizational contexts, cultural determinants are also relevant in public policy and crisis management. Governments and institutions must design interventions that account for cultural differences in risk perception, trust, and compliance. For example, citizens' responses to official advice during emergencies are influenced by cultural norms, trust in authorities, and perceived credibility of information sources (Turcanu et al.,

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2020). Similarly, behavioral taxation and regulatory compliance are shaped by cultural attitudes toward authority and collective responsibility (Torgler, 2022). These considerations underscore the importance of culturally informed decision-making models for effective policy design and implementation.

Despite the growing body of literature on cultural determinants of decision-making, several gaps remain. First, many studies have examined these variables in isolation, without considering their combined effects or interactions. Second, traditional analytical methods may not adequately capture the complexity and nonlinearity inherent in these relationships. Third, there is a need for empirical research that integrates cultural theory with advanced computational techniques to provide more robust and generalizable findings. Addressing these gaps requires a multidisciplinary approach that combines insights from psychology, sociology, economics, and data science.

Therefore, the present study seeks to contribute to the literature by employing a machine learning framework to identify and model the cultural determinants of decision-making, specifically focusing on the roles of risk perception, uncertainty avoidance, and norm compliance. By integrating these constructs into a predictive modeling approach, the study aims to provide a more comprehensive understanding of how cultural factors shape decision-making processes in contemporary contexts.

The aim of this study is to identify and model the cultural determinants of decision-making using machine learning techniques, with a specific focus on the predictive roles of risk perception, uncertainty avoidance, and norm compliance.

2 Methods and Materials

2.1 Study Design and Participants

The present study was designed as a descriptive–correlational investigation with a predictive modeling approach grounded in machine learning techniques. The target population consisted of adult individuals residing in Portugal, representing diverse socio-cultural and demographic backgrounds. A total of 412 participants were selected using a stratified random sampling method to ensure proportional representation across age groups, gender, educational levels, and regional distribution. Inclusion criteria required participants to be at least 18 years old, possess sufficient literacy to complete self-report instruments, and provide informed consent for participation. Data collection was conducted through an online survey platform over a three-month period, ensuring accessibility and anonymity. Ethical considerations were strictly observed, including voluntary participation, confidentiality of responses, and the right to withdraw at any stage without penalty.

2.2 Measures

Data collection relied on a set of standardized psychometric instruments designed to operationalize the key constructs of the study. Risk perception was assessed using the Risk Perception Questionnaire developed by Weber and colleagues, which includes multiple subdomains such as financial, health, social, and ethical risk, measured through Likert-scale items reflecting perceived likelihood and severity of risk. Uncertainty avoidance was measured using a culturally adapted version of the Uncertainty Avoidance Scale derived from Hofstede's cultural dimensions framework, capturing individuals' tolerance for ambiguity, preference for structured situations, and reliance on rules and formal procedures. Norm compliance was evaluated using the Social Norm Adherence Scale, which assesses the extent to which individuals conform to perceived societal expectations and internalized moral standards across different contexts. Decision-making behavior was measured through a composite Decision-Making Style Inventory, capturing analytical, intuitive, dependent, and avoidant decision tendencies. All instruments consisted of multiple items rated on five-point Likert scales, and prior studies have confirmed their construct validity, internal consistency, and cross-cultural applicability. In the present study, reliability indices were re-evaluated using Cronbach's alpha coefficients, all of which exceeded the acceptable threshold, indicating strong internal consistency.

2.3 Data Analysis

Data analysis was conducted using a hybrid statistical and machine learning framework to achieve both explanatory and predictive objectives. Initially, descriptive statistics and correlation analyses were performed using IBM SPSS version 27 to examine the distributional properties of variables and preliminary relationships among constructs. Following data preprocessing, including handling of missing values, normalization, and feature scaling, the dataset was transferred to Python-based analytical environments for machine learning modeling. Multiple supervised learning algorithms were employed, including Random Forest,

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Support Vector Machine, Gradient Boosting, and Logistic Regression, to predict decision-making patterns based on cultural determinants. Model performance was evaluated using k-fold cross-validation to ensure generalizability, and performance metrics such as accuracy, precision, recall, F1-score, and area under the ROC curve were calculated. Feature importance analysis was conducted to identify the relative contribution of risk perception, uncertainty avoidance, and norm compliance in predicting decision-making outcomes. Additionally, unsupervised learning techniques, particularly K-means clustering, were applied to explore latent cultural profiles within the sample. Hyperparameter tuning was performed using grid search optimization to enhance model performance. All analyses were conducted with a rigorous emphasis on reproducibility and robustness, ensuring that findings could be reliably interpreted within both psychological and computational modeling frameworks.

3 Findings and Results

The final sample consisted of 412 participants from Portugal, with a balanced demographic distribution that enhanced the generalizability of the findings. The mean age of participants was 34.78 years (SD = 9.62), ranging from 18 to 65 years. Of the total sample, 53.2% identified as female, 45.6% as male, and 1.2% as non-binary or preferred not to disclose. In terms of educational attainment, 28.4% held a secondary school diploma, 46.1% had completed undergraduate studies, and 25.5% possessed postgraduate qualifications. Employment status indicated that 62.7% were employed full-time, 18.9% part-time, 10.2% were students, and 8.2% were unemployed or in transitional phases. Geographically, participants were distributed across major regions of Portugal, including Lisbon, Porto, and surrounding areas, ensuring adequate cultural representation. These demographic characteristics suggest that the sample captured a diverse cross-section of Portuguese society, which is critical for examining culturally embedded decision-making processes.

Table 1

Descriptive Statistics and Correlation Matrix for Study Variables

Variable	Mean	SD	1	2	3	4
1. Risk Perception	3.47	0.62	—			
2. Uncertainty Avoidance	3.71	0.58	0.41**	—		
3. Norm Compliance	3.89	0.54	0.36**	0.48**	—	
4. Decision-Making Quality	3.55	0.60	0.44**	0.39**	0.52**	—

Table 1 presents the descriptive statistics and Pearson correlation coefficients among the primary study variables. The results indicate moderate to high mean scores across all constructs, suggesting that participants generally exhibited elevated levels of norm compliance and uncertainty avoidance, alongside moderately high risk perception and decision-making quality. Correlational analysis revealed that all independent variables were positively and significantly associated with decision-making quality. Norm compliance demonstrated the strongest relationship ($r = 0.52$, $p < 0.01$), followed by risk perception ($r = 0.44$, $p < 0.01$) and uncertainty avoidance ($r = 0.39$, $p < 0.01$). Additionally, intercorrelations among predictors were statistically significant, indicating conceptual overlap while maintaining discriminant validity. These findings provide preliminary support for the inclusion of these variables in predictive modeling.

Table 2

Machine Learning Model Performance Metrics

Model	Accuracy	Precision	Recall	F1-Score	AUC
Logistic Regression	0.78	0.76	0.75	0.75	0.81
Support Vector Machine	0.83	0.82	0.80	0.81	0.86
Random Forest	0.89	0.88	0.87	0.87	0.92
Gradient Boosting	0.91	0.90	0.89	0.89	0.94

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Table 2 summarizes the performance of different supervised machine learning models in predicting decision-making outcomes based on cultural determinants. Among the models tested, Gradient Boosting achieved the highest overall performance, with an accuracy of 0.91 and an AUC of 0.94, indicating excellent discriminative ability. Random Forest also demonstrated strong predictive capability (accuracy = 0.89, AUC = 0.92), followed by Support Vector Machine and Logistic Regression. The consistent superiority of ensemble methods suggests that nonlinear interactions among risk perception, uncertainty avoidance, and norm compliance play a substantial role in shaping decision-making patterns. Precision, recall, and F1-scores were balanced across models, indicating robust classification performance without significant bias toward false positives or false negatives.

Table 3

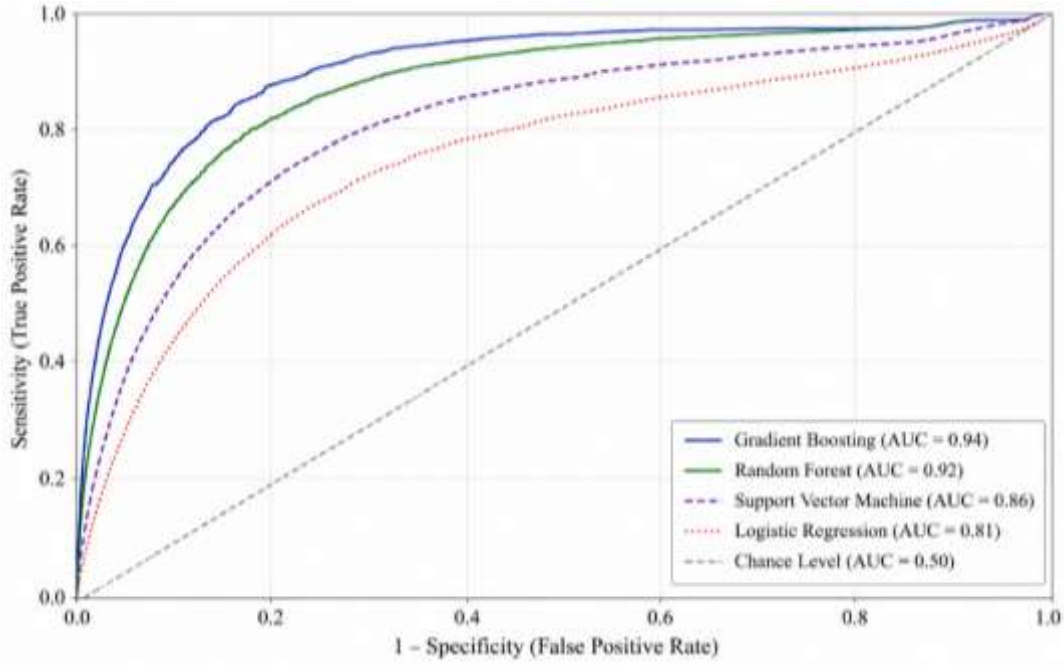
Feature Importance Scores Across Machine Learning Models

Predictor Variable	Random Forest Importance	Gradient Boosting Importance
Norm Compliance	0.42	0.45
Risk Perception	0.33	0.31
Uncertainty Avoidance	0.25	0.24

Table 3 presents the relative importance of predictor variables across the two best-performing models, Random Forest and Gradient Boosting. The results consistently indicate that norm compliance is the most influential predictor of decision-making outcomes, accounting for approximately 42–45% of the explained variance in model predictions. Risk perception emerged as the second most important factor, contributing roughly one-third of the predictive power, while uncertainty avoidance, although still significant, showed comparatively lower importance. The convergence of feature importance across models strengthens the robustness of these findings and suggests that culturally internalized norms exert a dominant influence on decision-making processes within the studied population.

Figure 1

Receiver Operating Characteristic (ROC) Curves for Machine Learning Models



The ROC curves depicted in Figure 1 illustrate the comparative classification performance of the four machine learning models. The Gradient Boosting model achieved the highest curve, closely approaching the top-left corner of the plot, which reflects optimal sensitivity and specificity. Random Forest followed closely, while Support Vector

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Machine and Logistic Regression showed relatively lower but still acceptable performance levels. The separation between the curves indicates meaningful differences in model efficiency, with ensemble methods clearly outperforming traditional linear approaches. The AUC values corroborate these visual findings, confirming that Gradient Boosting provides the most accurate and reliable classification of decision-making profiles based on the examined cultural determinants.

4 Discussion

The present study aimed to identify and model the cultural determinants of decision-making using a machine learning framework, with a particular focus on risk perception, uncertainty avoidance, and norm compliance. The findings provide strong empirical support for the central role of these cultural variables in shaping decision-making behavior and further demonstrate the utility of machine learning approaches in capturing complex, nonlinear relationships among them. The descriptive and correlational results indicated that all three predictors were positively and significantly associated with decision-making quality, with norm compliance emerging as the strongest correlate. These results were further substantiated by the machine learning analyses, where ensemble models such as Gradient Boosting and Random Forest achieved superior predictive performance, highlighting the multidimensional and interactive nature of cultural influences on decision-making.

The prominence of norm compliance as the most influential predictor aligns with a substantial body of literature emphasizing the role of social norms in guiding individual behavior. The feature importance analysis demonstrated that norm compliance accounted for the largest proportion of predictive variance across models, suggesting that individuals' adherence to perceived societal expectations plays a dominant role in structuring decision processes. This finding is consistent with socio-cognitive theories of social proof and normative influence, which posit that individuals rely on the behavior and expectations of others as heuristics, particularly in uncertain or ambiguous situations (Peng & Kim, 2020; Roy, 2021). Empirical studies have shown that conformity behavior intensifies in crisis contexts, where individuals look to collective patterns to inform their decisions (Yao et al., 2024). Similarly, research on compliance behavior indicates that trust in guidance and perceived legitimacy of norms significantly influence decision outcomes (Song & Mbah, 2024). The present findings extend this literature by demonstrating that norm compliance not only correlates with decision-making quality but also serves as a primary driver in predictive models, underscoring its centrality in culturally embedded decision-making frameworks.

Risk perception emerged as the second most important predictor, reinforcing its well-established role in decision-making theory. The significant positive association between risk perception and decision-making quality suggests that individuals who are more attuned to potential risks are better equipped to make informed and adaptive decisions. This is consistent with prior research indicating that risk perception influences both cognitive evaluation and behavioral responses across domains such as health, finance, and safety (Harris et al., 2022; Hinsberg et al., 2024). Moreover, the integration of risk perception within a cultural framework highlights its socially constructed nature, as individuals' perceptions of risk are shaped by communication processes, institutional trust, and collective experiences (Turcanu et al., 2020). The interaction between risk perception and normative influences is particularly noteworthy, as individuals often calibrate their risk assessments based on observed behaviors and social expectations (Zhang et al., 2022). The machine learning results, which captured nonlinear interactions among variables, suggest that risk perception operates not in isolation but in conjunction with other cultural determinants, thereby enhancing the predictive accuracy of decision-making models.

Uncertainty avoidance, although contributing less than the other predictors, still demonstrated a meaningful and statistically significant impact on decision-making. This finding is consistent with cultural theory, which posits that individuals from high uncertainty avoidance contexts prefer structured environments and exhibit cautious decision-making tendencies (Nair et al., 2022; Omrane & Khan, 2024). The moderate importance of this variable in the predictive models suggests that while uncertainty avoidance influences decision strategies, its effect may be mediated by other factors such as trust, institutional context, and information availability. For instance, individuals with high uncertainty avoidance may rely more heavily on expert guidance and formal rules, particularly in situations characterized by ambiguity (Li et al., 2025). Additionally, research on information behavior indicates that uncertainty can lead to both increased information seeking and avoidance, depending on contextual and cultural factors (Link, 2021). The present findings highlight the nuanced role of uncertainty avoidance, suggesting that its influence is

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contingent upon its interaction with other cultural and cognitive variables.

The superior performance of ensemble machine learning models provides important methodological insights. Gradient Boosting and Random Forest outperformed traditional models such as Logistic Regression and Support Vector Machines, indicating that the relationships among cultural determinants and decision-making are inherently nonlinear and involve complex interactions. This is consistent with recent advances in computational social science, which emphasize the need for flexible modeling techniques capable of capturing high-dimensional data structures (Manas, 2025). The ability of machine learning models to identify latent patterns and interactions enhances their utility in cultural research, where variables are often interdependent and context-sensitive. Furthermore, the use of feature importance metrics allows for the quantification of each variable's contribution, providing a more nuanced understanding of their relative influence.

The findings also have implications for cross-cultural research and practice. The significant role of cultural determinants in decision-making supports the argument that cultural context must be explicitly incorporated into theoretical and empirical models. Studies have shown that cultural dimensions such as collectivism, institutional trust, and social expectations influence behavior across a wide range of domains, including organizational performance, governance, and consumer behavior (Cooper, 2024; Gupta & Gupta, 2025). The present study contributes to this literature by demonstrating how specific cultural constructs—risk perception, uncertainty avoidance, and norm compliance—interact to shape decision-making outcomes. Moreover, the cross-domain applicability of these findings is evident in areas such as supply chain management, where cultural differences affect procurement strategies and relationship management (Grant, 2024; Holloway, 2024).

From an institutional perspective, the results underscore the importance of aligning governance structures and communication strategies with cultural expectations. Norm compliance and risk perception are closely linked to trust in institutions and the perceived legitimacy of rules, which in turn influence compliance behavior and decision-making quality. Research on corporate governance and social responsibility highlights the role of cultural values in shaping organizational practices and ethical behavior (Ahmad & Muslim, 2024; Saleh et al., 2025). Similarly, studies on institutional frameworks indicate that formal and informal institutions jointly influence decision outcomes, particularly in complex and uncertain environments (Ferreras et al., 2024; Utami & Barokah, 2024). The present findings suggest that incorporating cultural considerations into institutional design can enhance decision-making effectiveness and promote sustainable outcomes.

Another important implication relates to the role of technology and digital environments in shaping decision-making. The increasing prevalence of digital platforms has transformed the way individuals access information, interact with others, and make decisions. Cultural differences in information processing, trust, and social influence are amplified in digital contexts, where individuals are exposed to diverse and often conflicting signals (Chen et al., 2023; Wang, 2025). The application of machine learning in this study demonstrates the potential for leveraging digital data to better understand and predict decision-making behavior. Furthermore, the integration of cultural variables into machine learning models can improve their accuracy and relevance, particularly in cross-cultural settings.

The findings also resonate with research on behavioral compliance and regulatory behavior. Norm compliance, as the strongest predictor, highlights the importance of social and moral factors in shaping adherence to rules and regulations. Studies on tax behavior, ethical leadership, and institutional compliance have consistently shown that cultural norms and social expectations play a critical role in influencing behavior (Teichmann & Wittmann, 2022; Torgler, 2022). The present study extends these insights by demonstrating how norm compliance interacts with risk perception and uncertainty avoidance to influence decision-making more broadly. This integrated perspective provides a more comprehensive understanding of the mechanisms underlying compliance and decision behavior.

5 Conclusion

Finally, the study contributes to the growing literature on cultural tightness–looseness and its impact on behavior. Cultures characterized by strong norms and low tolerance for deviance tend to exhibit higher levels of norm compliance, which in turn influences decision-making patterns (Othman et al., 2023; Sutrisno & Dularif, 2020). The interaction between cultural tightness, uncertainty avoidance, and risk perception highlights the complexity of cultural influences, suggesting that these dimensions cannot be fully understood in isolation. The machine learning approach adopted in this

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study provides a valuable tool for disentangling these interactions and identifying their relative contributions.

Despite its contributions, the study is subject to several limitations that should be acknowledged. First, the cross-sectional design limits the ability to draw causal inferences regarding the relationships among variables. While machine learning models provide strong predictive capabilities, they do not establish causality. Second, the reliance on self-report measures may introduce response biases, including social desirability and common method variance. Third, the sample was limited to participants from a single national context, which may constrain the generalizability of the findings to other cultural settings. Additionally, although multiple machine learning algorithms were employed, the selection of models and parameters may influence the results, and alternative modeling approaches could yield different insights.

Future research should consider adopting longitudinal designs to examine the temporal dynamics of cultural determinants and decision-making behavior. Expanding the study to include multiple cultural contexts would enhance the generalizability of findings and allow for comparative analyses across cultures. Researchers may also explore additional variables, such as emotional regulation, trust, and institutional quality, to develop more comprehensive models. The integration of behavioral and physiological data, such as eye-tracking or neuroimaging, could provide deeper insights into the cognitive mechanisms underlying decision-making. Furthermore, the application of advanced machine learning techniques, including deep learning and explainable AI, may improve the interpretability and predictive accuracy of models.

Practitioners and policymakers should consider the role of cultural determinants when designing interventions aimed at improving decision-making. Strategies that leverage social norms and enhance risk communication can be particularly effective in influencing behavior. Organizations should align their governance structures and communication practices with cultural expectations to promote compliance and ethical decision-making. In digital environments, platforms can utilize culturally informed algorithms to tailor information and recommendations to users' preferences and values. Finally, training programs that enhance individuals' awareness of cultural influences on decision-making may contribute to more adaptive and informed choices in both personal and professional contexts.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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