



Neutrosophic Methods and Linguistic Tools for Interpreting Human Perceptions in Complex Decision-Making

María Lorena Merizalde Aviles¹, Emver Nivelá Ortega², Kleber Eduardo Carrion Leon³, Wiem Abdelbaki^{4,*}

¹Regional Autonomous University of Los Andes Ambato. Ecuador

²Regional Autonomous University of Los Andes Babahoyo. Ecuador

³Regional Autonomous University of Los Andes Santo Domingo. Ecuador

⁴College of Engineering and Technology, American University of the Middle East, Egaila 54200, Kuwait

Emails: ua.mariamerizalde@uniandes.edu.ec; ub.emverno47@uniandes.edu.ec; us.klebercarrion@uniandes.edu.ec; Wiem.Abdelbaki@aum.edu.kw

Abstract

This study addresses a particular issue in relation to the disambiguation of human views, which remains critical in the current era that is the quest for suitable instruments that can cognize, simulate, and interpret the multilayered nature of the standpoint. Today, in contexts where a decision must be made that requires a synthesis of different and often-opposed points of view, such methods are very limited. This methodological gap focuses on the question where ways and means are lacking, which combine analytical accuracy and the flexibility of approaches for dealing with huge amounts of complex and unstructured information. To mitigate this problem, the study seeks for the application of neutrosophic methods and languages as a new approach for understanding human perceptions, which present a great deal of uncertainty. From the combined angles of neutrosophic logic and special linguistic devices, images from different practical situations are scrutinized. The results indicate that this method not only enhances the accuracy with which human subjectivity is simulated but also renders stronger analytical models for application in the area of organizational strategy, public policy formulation and even marketing research. In conclusion, this research extends new and significant methodological boundaries to the social and applied sciences and provides a useful approach to the problem of interpretation and decision-making in a multidimensional and time-changing society.

Keywords: Human perceptions; Neutrosophic logic; Uncertainty; Ambiguity; Contradiction; Traditional methodologies; Decision making; Analytical tools; Neutrosophic language; Subjective models; Data analysis

1. Introduction

Over the years, there have been instances of violations of the individual right to express beliefs, some of which have been characterized by unprecedented levels of violence. History has witnessed conflicts rooted in religion and episodes of religious intolerance on several occasions. Although Ecuador has not experienced the levels of severity observed in other nations and regions, this reality demands deep reflection on the issue and the provision of resources to provide society with the necessary tools to promote maturity in respecting the human right to religious freedom.

The rights relating to freedom of thought, conscience, and religion constitute fundamental facets of the individual's rational capacity, that is, the qualities that allow the person to exercise his or her actions and express them through his or her behavior in the social world autonomously and without being forced to make changes by external influences. In this context, religious freedom or freedom of religion refers to the right to have or not have a religious affiliation and to live following it. This notion encompasses not only the adoption of a position regarding faith, but also the practice of the religion chosen by the individual or individuals, ensuring the freedom to carry out acts of preaching, worship, teaching, observance, and, where appropriate, abandoning said religion.

Religious freedom is characterized by its various facets, in this perspective, can be expressed, and practiced both in individual and collective terms. In this context, it is clear that, alongside the individual or personal dimension, there is a collective dimension of religious freedom, which is of crucial importance. This community dimension is essential because many of the rights that constitute its core cannot be exercised in isolation, but require collective and associative action. In this sense, these rights do not belong exclusively to individuals, but acquire their primary relevance in the context of religious communities.

This collective dimension imposes on the State the responsibility of ensuring adequate recognition of religious groups. It is therefore not enough to affirm that individual religious freedom is not denied to any particular person; it is necessary to carefully examine how this freedom is guaranteed, both at the level of individuals and of churches and religious communities.

The Declaration on the Rights of Persons Belonging to National, Ethnic, Religious, and Linguistic Minorities recognizes the right of persons belonging to national, ethnic, or linguistic minorities to profess and practice their religion. Internationally recognized as a fundamental right, religious freedom grants individuals the ability to profess and express their religious convictions by their beliefs and values. However, in prison contexts, this right may be subject to exceptional challenges due to the restrictions inherent in the prison environment. Prisons represent places of psychological distress and suffering, so examining the role of religion in them explores the implications of this and the need to maintain a psychosocial perspective [1,2,3].

Ecuador, a country characterized by rich cultural and religious diversity, brings a significant nuance to the analysis of religious freedom rights in the prison population, contributing to understanding how these issues are addressed in the context of a pluralistic society. The city of Quevedo, located in the province of Los Ríos, Ecuador, emerges as an ideal study area to explore the intersection between religious freedom and the prison system. In this context, the need arises to analyze the perception of religion among inmates in the Quevedo prison system, considering the legal, cultural and social implications that this entails. The study aims to shed light on the challenges and opportunities to guarantee this fundamental right in an environment where the limitations of prison can influence its exercise from a neutrosophic perspective.

2. International and national legal framework

In international law, freedom of religion was first established in the Universal Declaration of Human Rights (1948) and further developed years later in the International Covenant on Civil and Political Rights (1966). The right to freedom of religion includes [4, 25]

- i. The freedom of individuals to adopt the religion or belief of their choice; and,
- ii. The freedom of individuals to manifest their religion individually and collectively, in public or in private, through worship, observance of rituals, practices and teaching.

By virtue of the freedoms conferred by this right, the State has the obligation not to dictate coercive measures that undermine freedom of religion; in this regard, this right shall be subject only to the limitations indicated by law. Likewise, the State is obliged to respect the freedom of parents (legal guardians) to ensure that their sons and daughters receive a religious and moral education in accordance with their convictions.

Ecuador is a signatory to various international instruments that recognize and protect religious freedom as a fundamental human right. They are the following: Universal Declaration of Human Rights (1948), American Declaration of the Rights and Duties of Man (1948), International Convention on the Elimination of All Forms of Racial Discrimination (1969), International Covenant on Civil and Political Rights (1976), American Convention on Human Rights (1977), Declaration on the Elimination of All Forms of Intolerance and of Discrimination Based on Religion or Belief (1981), Convention on the Rights of the Child (1990), Declaration on the Rights of Persons Belonging to National or Ethnic, Religious and Linguistic Minorities (1993), Inter-American Convention on the Prevention, Punishment and Eradication of Violence against Women (1995), International Convention on the Protection of the Rights of All Migrant Workers and

Members of Their Families (2003), and the United Nations Declaration on the Rights of Indigenous Peoples (2007).

Ecuador's national legal framework reflects the country's commitment to protecting and guaranteeing religious freedom in prison populations and in society. These legal provisions support religious diversity and seek to ensure that people's rights are respected and promoted, thus contributing to building an inclusive society that respects individual beliefs.

The Constitution of the Republic of Ecuador establishes fundamental principles that support religious freedom in the country. In Title I, Chapter I, articles 1 and 3 recognize the cultural, ethnic, and religious diversity of the nation. In Title II, Chapter I, articles 10 and 11 establish the principles of universality and indivisibility of rights and the duty of the State to respect and guarantee the exercise of human rights, including religious freedom. In Title II, Chapter II, articles 16 to 34 detail the rights of Buen Vivir, which include the right to freedom of thought, conscience, religion, and the prohibition of discrimination on religious grounds. Likewise, in Title II, Chapter VI, article 66 reinforces respect for religious freedom [5,26].

This paper presents the linear model, which is the direct simplex method using neutrosophic logic, a logic that represents a new modeling approach and is designed to effectively address the uncertainties inherent in the real world, as founded by the Romanian mathematician Florentine Smarandache [6, 7]. Furthermore, the neutrosophic classical category theory has been introduced as a generalization of classical category theory in [8, 9]; furthermore, new concepts in several disciplines of mathematics, statistics, and computer science have been developed, introduced, and formulated through neutrosophic theory in [10 - 13].

3. Related work

3.1. Materials and methods

The research design was characterized by being mixed, combining quantitative and qualitative approaches to obtain a comprehensive and holistic understanding of the phenomenon under study. A survey was used as the main data collection instrument, which allowed the collection of quantitative data for the analysis of trends and frequencies, as well as the inclusion of open questions to capture qualitative responses and enrich the understanding of the experiences and perceptions of participants using neutrosophic language.

The population studied was the inmate population of the city of Quevedo. A sample of 300 inmates from different penitentiary centers was selected, who voluntarily agreed to participate in the study.

The use of neutrosophic theory in the study ensures that the uncertainty inherent in decision-making is taken into account, including indeterminacies where experts will provide their assessments by evaluating linguistic rather than numerical terms, which is the most natural form of measurement in humans [10-16]. Neutrosophic logic and sets in this field of decision-making and machine learning are worked with single-valued neutrosophic numbers (SVNN) [10-23]. The work with these, based on [14-15], is explained below:

be $N = \{(T, I, F): T, I, F \subseteq [0, 1]\}$ a neutrosophic evaluation of an application of a group of propositional formulas to N , and for each sentence p :

$$v(p) = (T, I, F) \tag{1}$$

To facilitate the practical application in real-world problems [7,27], the use of Single Value Neutrosophic Sets (SVNS) was proposed, through which it is possible to use linguistic terms to obtain a greater interpretability of the results [8]. Let X be a universe of discourse, an SVNS A over X has the following form [9]: $A = \{(x, u_a(x), r_a(x), v_a(x)): x \in X\}$, where $u_a(x): X \rightarrow [0, 1], r_a(x): X \rightarrow [0, 1], v_a(x): X \rightarrow [0, 1]$, with $0 \leq u_a(x), r_a(x), v_a(x) \leq 1, \forall x \in X$. The intervals $u_a(x), r_a(x)$ and $v_a(x)$ denote the true, indeterminate and false-related memberships of x in A , respectively [9,10]. For convenience, a Single Valued Neutrosophic Number (SVN) is expressed as $A = (a, b, c)$, where $a, b, c \in [0,1]$ and $0 \leq a + b + c \leq 3$ [20,28].

Let $A = (a, b, c)$ be a single-valued neutrosophic number, a scoring function S is defined related to a single-valued neutrosophic value, based on the degree of belonging to truth, the degree of belonging to indeterminacy and the degree of belonging to falsehood [21,29]:

$$s(V_i) = 2 + T_i - F_i - I_j \tag{2}$$

4. Neutrosophic framework for the study of religious perception in penitentiary centers

In this space, a framework is established to classify the sentiments and perceptions of religious acceptance in the prisons of the Quevedo canton. The degrees of truth (T), falsehood (F), and indeterminacy (I) are analyzed, in a broader spectrum than the classic studies that classify the elements as positive, negative, or neutral. The neutrosophic linguistic scale [14, 15] was used, expressed as follows:

Table 1: Linguistic terms used.

| Neutrosophic linguistics | | Dictionary of perception |
|-------------------------------------|-------------------|---|
| Extremely noticeable (EP) | (1, 0, 0) | Superlatives and emphasis are used to express strong approval of what is being studied. It is a firm conviction of religious perception. Extremely favorable reactions. |
| Very Perceptible (VP) | (0.8,0.15,0.20) | Clear positive expressions without excessive emphasis. Shows support for religion. Positive opinions with some nuances or conditions. |
| Slightly noticeable (SP) | (0.60,0.35,0.40): | Positive comments with some reservations or lack of emphasis. Indicates a positive opinion but with some doubts. |
| Neutral (N) | (0.50,0.50,0.50) | Aspects that do not give a clear judgment or express an impartial opinion. It denotes a balanced position or lack of a firm opinion towards either side. |
| Slightly imperceptible (YES) | (0.40,0.65,0.60) | Slightly negative expressions or doubts using unfavorable words. Expresses some dissatisfaction or concern about religion. |
| Very imperceptible (VI) | (0.20,0.85,0.80) | Expressions that denote clear opposition without going to extremes. Shows significant disagreement or concern about religion without being overly critical. |
| Extremely imperceptible (EI) | (0,1,1) | Use of superlatives and emphasis to express strong rejection. Indicates categorical and unequivocal rejection of religion. |

Source: Own elaboration.

5. Knowledge and perception of religion from the processing of the applied instrument

The survey covered a variety of areas, including perception of religious rights, participation in religious practices, and potential obstacles and improvements in the exercise of religious freedom. Regarding the demographic characteristics of respondents, a predominance of male participation was observed, with 76% of men versus 24% of women. This gender distribution reflects a significantly higher proportion of men in the prison population studied. The neutrosophic category of imperceptible shows a greater representation in the negative aspects for men (0.20, 0.85, 0.80). Women are more perceptive on religious issues (Figure 1).

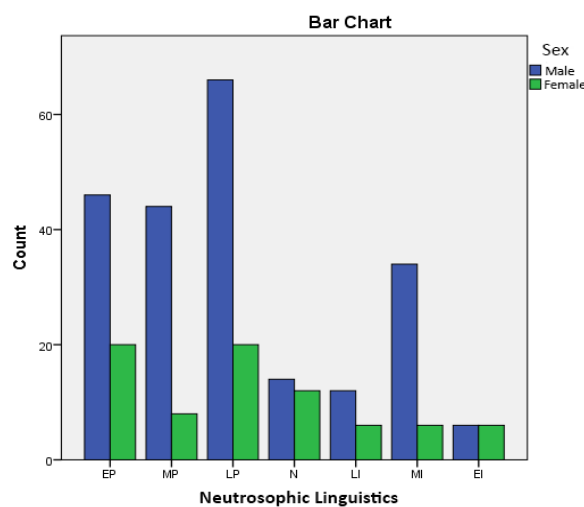


Figure 1. Correspondence analysis between neutrosophic categories and respondents' gender. Source: SPSS 22 Output.

58% of respondents were between 25 and 34 years old. This trend suggests that the young adult group is the most representative of the prison population involved in the research. Regarding the length of imprisonment, it is observed that 42% of the participants had been imprisoned for a period ranging from 1 to 3 years (Figure 2). This figure indicates that a considerable proportion of the sample has experienced a short to medium-term period of confinement in the prison context. The neutrosophic category is slightly perceptible and corresponds more to the time mentioned (0.60, 0.35, 0.40).

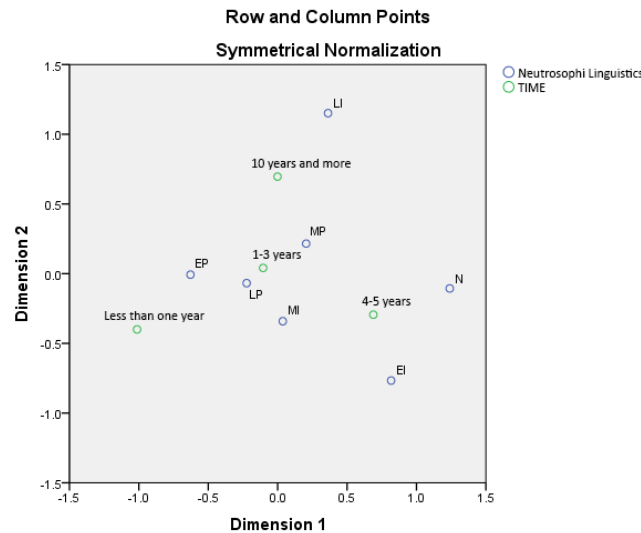


Figure 2. Correspondence analysis between neutrosophic categories and length of prison sentence. Source: SPSS 22 Output.

The analysis of these demographic characteristics provides a first picture of the profile of the research participants, which is crucial to contextualize and understand the perceptions and experiences related to religious freedom in the prison context. These figures served as a basis for the interpretation and discussion of the results according to the corresponding neutrosophic category.

In the context of perceptions on religious freedom in the penitentiary context, the data collected show a mixed trend between knowledge of religious rights and perception of their compliance. It is worth noting that a significant percentage of the inmates surveyed, equivalent to 68% (Table 2), claimed to be perceptive regarding the issue of religion, regarding their rights in terms of freedom of belief and worship in the penitentiary center. This result suggests that there is a level of awareness and knowledge among a considerable part of the prison population regarding their religious rights.

Table 2: Frequencies of neutrosophic linguistics. Source: SPSS 22 Output.

| | | Frequency | Percent | Valid percentage | Cumulative percentage |
|-------|--------|-----------|---------|------------------|-----------------------|
| Valid | PE | 66 | 22.0 | 22.0 | 22.0 |
| | Deputy | 52 | 17.3 | 17.3 | 39.3 |
| | LP | 86 | 28.7 | 28.7 | 68.0 |
| | north | 26 | 8.7 | 8.7 | 76.7 |
| | HE | 18 | 6.0 | 6.0 | 82.7 |
| | MY | 40 | 13.3 | 13.3 | 96.0 |
| | EI | 12 | 4.0 | 4.0 | 100.0 |
| | Total | 300 | 100.0 | 100.0 | |

However, it is important to contrast this figure with the fact that only 45% of respondents reported feeling that prison authorities respected their religious beliefs. This discrepancy between knowledge of rights and perceptions of their respect raises questions about the effective implementation of policies and practices that should guarantee religious freedom in the prison environment. Factors such as communication and interpretation of policies can influence this gap between knowledge and experience.

A simple correspondence analysis indicates that among those aged 25-34, the majority perceive their right to religion, with the 25-29 age group being predominantly represented in the neutrosophic categories of extremely perceptible (1,0,0) and very perceptible (0,8,0,15,0,20). In addition, the 30-34 age group is represented in the neutrosophic category of very imperceptible (0,20, 0,85, 0,80). (Figure 3)

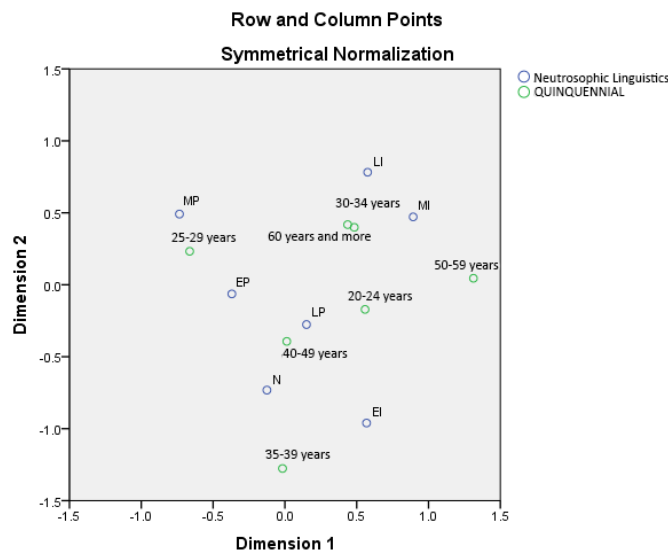


Figure 3. Correspondence analysis between neutrosophic categories and age of respondents. Source: SPSS 22 Output.

The dimension of religious participation in the prison setting emerges as a highlight in the data analysis. The survey revealed a significant prevalence of participation in religious activities among the inmates surveyed. With a remarkable 82% of respondents stating that they had the opportunity to participate in religious practices within the prison, the importance of religion in the life of the prison population is evident.

Within the spectrum of religious activities, the results indicate that worship services and group prayers are the most common practices, with 64% and 53% of participants engaged in these aspects, respectively. These findings highlight the relevance of religion as a tool for cohesion and support within the prison environment. Participation in these practices can contribute to the formation of communities and provide prisoners with a means to express their beliefs and values, which in turn could have positive implications for their emotional and psychological well-being.

The data obtained through the survey shed light on the concerns faced by prisoners concerning the exercise of their religious freedom in the prison context. Alarming, a significant 61% of respondents reported facing obstacles or difficulties in exercising their right to religious freedom. The obstacles identified by prisoners expose areas where there are deficiencies in facilitating religious freedom:

- Lack of access to religious materials was cited as a major challenge by 38% of respondents, suggesting that the availability of religious literature and objects may be an issue requiring attention.
- Additionally, 25% cited restrictive schedules as a problem, pointing to the need for flexibility in scheduling religious activities to accommodate diverse beliefs and practices.

The perception that improvements can be made in access to and an overwhelming majority of respondents shares exercise of religious freedom, with 78% expressing this opinion. These results suggest that there is a widespread awareness among the prison population that there is stillroom for improvement to guarantee this fundamental right in the penitentiary context.

Additional comments provided by inmates in the survey provide a more complete perspective on how religious freedom affects their emotional and spiritual well-being during incarceration. Numerous respondents expressed the fundamental importance of religious freedom to their psychological and emotional well-being while incarcerated.

The recurring mention of the lack of adequate spaces for religious practice and the need for more opportunities to interact with religious leaders is a clear indication that there is an unmet need in terms of

facilitating an enabling environment for the exercise of religion in prisons. These comments reinforce previous findings related to the obstacles and challenges to accessing and exercising religious freedom.

In this regard, prisoners' voices highlighted the importance of considering not only legal theory and formal policies, but also practical conditions affecting religious freedom in the prison setting. Interaction with religious leaders also emerges as a relevant aspect, as it can provide spiritual and community support to prisoners, thus contributing to their overall well-being.

6. Results and discussion

The application of religious freedom in prison settings is an area that must be respected to ensure respect for prisoners' human rights. Despite the restrictive nature of prison settings, prisoners must be able to exercise their right to religious freedom.

The Regulations on the Regime and Sanctions of Centers of Deprivation of Liberty establish the obligation to respect the religious freedom of inmates and guarantee their right to religious practice. However, the results of the survey showed that only 45% of inmates felt that the prison authorities respected their religious beliefs. This underlines the need to implement effective policies and practices to ensure that inmates can exercise their religious freedom without impediments.

The results of the study highlight that there are extremely perceptible and imperceptible responses, but more intermediate positions are observed, for both men and women, which reflects indeterminacy and diversity.

Religious participation in the prison environment emerges as an important aspect, with a large percentage of prisoners reporting having participated in religious activities. This high percentage suggests that religion plays an important role in prisoners' lives and may have positive implications for their emotional and psychological well-being. These results are consistent with research that has highlighted the importance of religion as a source of support and community in prison settings [24].

Despite the existence of a legal and regulatory framework recognizing religious freedom in prison populations, challenges were identified in its effective implementation. At least two-thirds of prisoners reported facing obstacles in accessing religious practices and sacred materials due to resource constraints and the dynamics of prison facilities. Furthermore, the majority of them believe that improvements can be made in accessing and exercising religious freedom. These findings underscore the importance of adopting measures to overcome the identified obstacles and ensure that prisoners can fully exercise their religious rights.

The need to train prison staff in religious matters, allocate adequate resources to religious activities and promote tolerance and respect among prisoners are emerging as priority measures to ensure that prisoners' religious rights are effectively respected and guaranteed. These results indicate specific directions for action and continued improvement in the management of religious freedom rights in the prison environment.

7. Conclusion

The results of this research reflect a mix of perceptions and experiences around religion in penitentiary centres in the Quevedo region. A wide range of international and national standards was found that validate the right to religious freedom in the penitentiary context. However, the need for a clearer implementation of these standards in prisons was identified. It was observed that, while most inmates participate in religious activities and are aware of their rights, the perception of a lack of respect by the authorities and the obstacles encountered in religious practice are issues of concern.

Furthermore, it was revealed that the main challenges and obstacles in this area include the lack of material and human resources, discrimination, and inadequate training of prison staff. These results underline the need to improve the implementation and respect of religious freedom in the prison context, including access to religious materials and the creation of adequate spaces for religious practice. Promoting an inclusive and respectful environment that ensures the exercise of religious freedom could positively contribute to the emotional and spiritual well-being of prisoners in the Quevedo region.

Increased training of prison staff on the religious rights of prisoners and the promotion of inclusive religious programs are recommended. In addition, greater attention should be paid to religious diversity and interfaith tolerance should be promoted to improve prison coexistence and strengthen the rehabilitation of prisoners.

The need to use neutrosophic language to analyze the perception of religion in penitentiary centers is highlighted since it allows capturing the emotions and feelings of the individuals involved in the study, as demonstrated.

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