

Semantic Network Analysis of Bioethical Discourses: Mapping Anthropocentrism, Responsibility, and Governance

Julio E Crespo¹ , Juan Guillermo Mansilla Sepúlveda² , Rosa María Rincón Ornelas³ ,
Jorge Hernández Valdés⁴ , Cruz García Lirios⁵ , Celia Yaneth Quiroz Campas⁶ 

¹Universidad de Los Lagos, Osorno, Chile

²Universidad Católica de Temuco, Chile

³Universidad de Sonora, Navojoa, México

⁴Universidad Nacional Autónoma de México

⁵Universidad de la Salud, México

⁶Instituto Tecnológico de Sonora, Navojoa, México

Corresponding author(s):

Julio E Crespo

Keywords: Bioethical discourse;
Anthropocentrism;
Semantic network analysis;
Responsibility;
Governance; Ethical frameworks

Received: 20/01/2026

Revised: 05/02/2026

Accepted: 18/02/2026



© 2026
by the
authors.

Submitted for possible
open access publication
under the terms and
conditions of the

[Creative Commons
Attribution \(CC BY\)
license](https://creativecommons.org/licenses/by/4.0/).

Abstract

This study analyzes the discursive structure of contemporary bioethical debates through semantic network analysis, with a specific focus on the role of anthropocentrism in articulations of responsibility and governance. Drawing on a corpus of academic articles, policy documents, and institutional bioethics texts published between 2000 and 2024, the research empirically maps conceptual associations that organize ethical reasoning. Rather than treating anthropocentrism as a fixed normative position, the study examines it as a semantic hub whose centrality and relational patterns can be systematically assessed. Network metrics such as degree centrality, betweenness centrality, and modularity reveal that anthropocentrism occupies a dominant and mediating position within bioethical discourse, strongly connected to notions of human agency, technological development, and institutional governance, while concepts related to non-human life and ecological integrity remain peripheral. These findings clarify how human-centered assumptions are discursively stabilized across ethical, technological, and governance-oriented domains. Methodologically, the study demonstrates the value of semantic network analysis for enhancing transparency and replicability in discourse-based bioethical research. Substantively, it highlights the structural limits of prevailing bioethical frameworks in addressing long-term ecological and intergenerational concerns within contemporary governance contexts.

1. Introduction

Bioethics has become a central field for examining the moral implications of scientific and technological development, particularly in relation to human life, environmental sustainability, and collective responsibility. Since its institutional consolidation in the second half of the twentieth century, bioethical reasoning has been predominantly structured around anthropocentric assumptions that privilege human agency, rationality, and interests as the primary criteria for ethical evaluation. While this orientation has facilitated the formulation of

influential principles and regulatory frameworks, it has also generated enduring tensions regarding the moral status of non-human entities, ecological systems, and future generations.

In recent decades, these tensions have intensified in response to global risks associated with climate change, biodiversity loss, and the expanding scope of technological intervention. Critical bioethical perspectives increasingly question whether human-centered ethical frameworks are adequate for addressing problems characterized by temporal extension, ecological interdependence, and irreversible consequences. Although post-anthropocentric, biocentric, and ecocentric approaches have gained visibility in theoretical debates, anthropocentric reasoning continues to dominate applied bioethics, particularly in institutional, policy-oriented, and governance-related contexts.

Understanding the persistence of anthropocentrism in bioethics requires moving beyond purely normative critique toward systematic analysis of how ethical meanings are discursively produced and stabilized. Bioethics functions not only as a philosophical field but also as a structured discourse in which concepts such as responsibility, governance, risk, and sustainability acquire meaning through patterned semantic associations. These associations shape how ethical problems are framed, which actors are recognized as morally relevant, and which forms of responsibility are rendered legitimate.

Discourse-oriented approaches have demonstrated that ethical vocabularies play a regulatory role in science and technology governance by delimiting acceptable interpretations and policy responses. However, much of this research relies on qualitative analysis or theoretical argumentation, offering limited empirical insight into the relational structure of bioethical language. As a result, there remains insufficient evidence on how anthropocentrism is organized at the level of discourse, which concepts it connects, and how alternative ethical perspectives are positioned within the broader semantic field.

Semantic network analysis provides a methodological framework capable of addressing this gap by modeling ethical discourse as a network of interconnected concepts. By representing concepts as nodes and their co-occurrences as relational ties, this approach allows for the systematic identification of central, peripheral, and bridging elements within complex discursive structures. Applied to bioethical texts, semantic network analysis enables empirical assessment of whether anthropocentrism functions as a dominant semantic hub and how it mediates connections between responsibility, governance, and technological reasoning.

The purpose of this study is to examine the structural role of anthropocentrism in contemporary bioethical discourse through semantic network analysis. Specifically, it seeks to determine how anthropocentric assumptions are semantically linked to responsibility and governance across academic and institutional texts, and to assess the relative visibility of non-anthropocentric concepts within the discourse. By integrating discourse-based empirical analysis with critical bioethical concerns, the study contributes to a more transparent and replicable understanding of how ethical frameworks are discursively organized, and it clarifies the limitations that human-centered semantics may impose on bioethical responses to socio-ecological challenges.

2. Method

This study adopts a quantitative, exploratory, and relational research design based on semantic network analysis, with the aim of empirically examining the structural role of anthropocentrism within contemporary bioethical discourse. Semantic network analysis is particularly appropriate for this purpose, as it enables the systematic modeling of discursive structures by representing concepts as nodes and their semantic associations as relational ties, allowing for the identification of central, peripheral, and mediating elements within complex ethical debates.

The empirical corpus consists of English-language texts published between 2000 and 2024, including peer-reviewed academic articles, international policy reports, and institutional bioethics documents. These sources were selected to capture bioethical discourse as it circulates across academic, governance, and regulatory contexts. Documents were retrieved from open-access academic databases and official repositories of international organizations using standardized search terms related to bioethics, ethics of technology, sustainability, responsibility, and governance. Duplicate texts and documents lacking substantive ethical content were excluded.

A probabilistic sampling strategy was applied to the resulting corpus to ensure representativeness while maintaining analytical feasibility. The required sample size was calculated using the finite population formula proposed by Cochran, with a confidence level of 95 percent, a margin of error of 5 percent, and a conservative estimated proportion of relevant semantic content. This procedure ensured that the selected sample adequately reflected the diversity of bioethical discourse within the defined population of texts.

Prior to analysis, all texts underwent a standardized preprocessing procedure. This included tokenization, lemmatization, and the removal of stop words and non-substantive terms. Semantic extraction followed a hybrid approach combining dictionary-based identification of key ethical concepts with frequency thresholds to retain semantically meaningful terms. Concepts were considered related when they co-occurred within a defined textual window, operationalized at the paragraph level to balance contextual coherence and analytical sensitivity.

The semantic network was modeled as an undirected weighted graph, where nodes represent ethical concepts and edges represent normalized co-occurrence frequencies. Edge weights reflect the relative strength of semantic association between concepts across the corpus. Network construction and metric computation followed established procedures in network text analysis to ensure consistency and comparability.

To assess the structural role of anthropocentrism, centrality measures were calculated, including degree centrality and betweenness centrality. Degree centrality was used to estimate the extent of direct semantic connectivity, while betweenness centrality captured the mediating role of concepts across different thematic clusters. In addition, global network properties such as density and modularity were computed to characterize the overall structure of bioethical discourse. Community detection algorithms were applied to identify semantically coherent clusters within the network.

To enhance transparency and replicability, robustness checks were conducted by varying co-occurrence window sizes and frequency thresholds. The stability of key findings was assessed by comparing centrality rankings across alternative parameter settings. Validity was addressed through triangulation between theoretical expectations derived from bioethical scholarship and the observed semantic structures, ensuring conceptual consistency between normative debates and empirical patterns.

3. Results

The semantic network constructed from the bioethical corpus exhibits a moderately dense structure, reflecting frequent conceptual co-occurrence across academic, policy, and institutional texts. As shown in Table 1, the network comprises 128 nodes and 742 edges, with a density of 0.091 and an average degree of 11.59. This configuration indicates a relatively integrated discourse in which ethical concepts are repeatedly linked rather than appearing in isolation. The modularity value ($Q = 0.42$) suggests the presence of coherent semantic clusters, while still allowing for cross-cluster connectivity through bridging concepts.

Table 1. Global Descriptive Metrics of the Bioethical Semantic Network

Metric	Value
Number of nodes	128
Number of edges	742
Network density	0.091
Average degree	11.59
Modularity (Q)	0.42

Note. Network density reflects the proportion of realized semantic associations relative to all possible associations. Modularity values indicate the presence of cohesive semantic clusters within the discourse.

Within this structure, anthropocentrism emerges as the most central concept in the network. Table 2 shows that anthropocentrism has the highest degree centrality (0.67), indicating that it is directly connected to a larger number of concepts than any other node. Its strongest associations are with responsibility, governance, technology, and human agency, demonstrating that human-centered ethical assumptions are tightly interwoven with discussions of institutional regulation, technological development, and moral accountability. The prominence of these connections confirms that anthropocentrism is not confined to abstract ethical reflection but is embedded in applied and governance-oriented bioethical discourse.

Table 2. Top Ten Concepts by Degree Centrality

Rank	Concept	Degree Centrality
1	Anthropocentrism	0.67
2	Responsibility	0.61
3	Governance	0.58
4	Technology	0.55
5	Human Agency	0.53
6	Sustainability	0.49
7	Risk	0.47
8	Innovation	0.45
9	Ethics	0.44
10	Policy	0.42

Note. Degree centrality indicates the extent to which a concept is directly connected to other concepts within the semantic network.

Betweenness centrality results further clarify the structural role of anthropocentrism. As reported in Table 3, anthropocentrism also displays the highest betweenness centrality value (0.34), indicating that it functions as a key intermediary connecting otherwise distinct semantic clusters. This bridging role suggests that anthropocentrism mediates the discursive relationship between responsibility-oriented concepts and governance-related frameworks. Concepts such as responsibility and governance also exhibit notable betweenness scores, but to a lesser extent, reinforcing the interpretation that anthropocentrism occupies a privileged position in structuring ethical meaning across domains.

Table 3. Betweenness Centrality of Selected Concepts

Concept	Betweenness Centrality
Anthropocentrism	0.34

Concept	Betweenness Centrality
Responsibility	0.29
Governance	0.27
Sustainability	0.18
Ecology	0.09
Non-human life	0.06

Note. Betweenness centrality captures the extent to which a concept functions as a bridge between different semantic clusters.

Community detection analysis identifies four main semantic clusters within the network, as summarized in Table 4. The cluster labeled Human-Centered Ethics is organized around anthropocentrism, human agency, and ethics, forming the normative core of the discourse. This cluster maintains strong interconnections with the Responsibility and Control cluster and the Institutional Governance cluster, indicating that ethical reasoning centered on the human subject extends directly into regulatory and administrative contexts. In contrast, the cluster labeled Ecological Concerns, which includes sustainability, ecology, and biodiversity, remains more weakly connected to the rest of the network.

Table 4. Semantic Clusters Identified Through Community Detection

Cluster	Dominant Concepts	Thematic Label
1	Anthropocentrism, Human Agency, Ethics	Human-Centered Ethics
2	Responsibility, Risk, Technology	Responsibility and Control
3	Governance, Policy, Regulation	Institutional Governance
4	Sustainability, Ecology, Biodiversity	Ecological Concerns

Note. Clusters represent groups of concepts that co-occur more frequently with each other than with the rest of the network.

The relative marginalization of non-anthropocentric perspectives becomes more evident when comparing centrality scores across concept types. Table 5 shows a substantial disparity between the mean centrality of anthropocentric concepts (0.56) and non-anthropocentric concepts (0.21). This difference quantitatively demonstrates that concepts related to non-human life and ecological integrity occupy peripheral positions in the semantic structure of bioethical discourse, limiting their influence on the overall organization of ethical reasoning.

Table 5. Comparison of Mean Centrality Scores by Conceptual Orientation

Concept Type	Mean Centrality
Anthropocentric concepts	0.56
Non-anthropocentric concepts	0.21

Note. Mean centrality scores summarize the relative structural prominence of concept groups within the semantic network.

Taken together, the results consistently indicate that anthropocentrism functions as a dominant semantic hub within bioethical discourse. Its high degree and betweenness centrality, combined with its cross-cluster connectivity, show that human-centered assumptions organize ethical discussions of responsibility and governance at a structural level. At the same time, ecological and non-human concepts remain discursively present but structurally subordinate, highlighting an imbalance in the semantic architecture of contemporary bioethics.

4. Discussion

The findings of this study provide empirical evidence that anthropocentrism continues to function as a central organizing structure in contemporary bioethical discourse. The semantic network analysis demonstrates that anthropocentrism occupies the most prominent position in terms of degree and betweenness centrality, indicating that human-centered assumptions are not merely present but structurally embedded in the discursive articulation of responsibility and governance. This result supports the study's central objective by showing how anthropocentrism operates as a semantic hub that connects ethical reasoning across normative, technological, and institutional domains.

The strong associative ties between anthropocentrism, responsibility, and governance suggest that bioethical discourse tends to frame moral accountability primarily in terms of human decision-making and institutional control. Responsibility appears discursively aligned with mechanisms of regulation, risk management, and technological oversight, reinforcing an instrumental orientation toward ethics. This pattern indicates that bioethics, as reflected in the analyzed texts, often functions to stabilize governance frameworks rather than to fundamentally question their underlying anthropocentric premises.

The bridging role of anthropocentrism, as evidenced by its high betweenness centrality, further clarifies its discursive function. By mediating connections between distinct semantic clusters, anthropocentrism facilitates the integration of ethical language into governance-oriented narratives. In contrast, concepts related to ecology and non-human life exhibit limited intermediary capacity, indicating that they remain weakly integrated into the core structure of bioethical discourse. Their presence does not substantially alter the dominant semantic pathways through which ethical meaning is organized.

These results also highlight the discursive marginalization of non-anthropocentric perspectives. Although terms associated with sustainability and ecological concern are present, their lower centrality and cluster confinement suggest that they are incorporated in a peripheral or compartmentalized manner. This structural positioning limits their influence on the overall configuration of ethical reasoning and supports critiques that environmental values are often absorbed into human-centered frameworks without challenging their normative foundations.

From a methodological standpoint, the study demonstrates the analytical value of semantic network analysis for bioethical research. By making visible the relational architecture of ethical discourse, this approach complements normative and qualitative analyses with empirically grounded insights. The use of network metrics allows for transparent and replicable assessment of conceptual prominence and mediation, addressing a methodological gap in discourse-based bioethics.

The implications of these findings extend to debates on governance and ethical reflexivity. If bioethical discourse remains structurally anchored in anthropocentric semantics, its capacity to engage with long-term, intergenerational, and non-human concerns may be constrained. This limitation does not stem from the absence of alternative ethical concepts but from their peripheral integration within the discursive network. Recognizing this structural condition is a necessary step toward developing more inclusive ethical vocabularies and governance frameworks capable of addressing complex socio-ecological challenges.

5. Conclusion

This study examined the role of anthropocentrism in contemporary bioethical discourse through semantic network analysis. The results show that anthropocentrism occupies a structurally central position, characterized by high levels of connectivity and mediation within the semantic network. Its strong associations with responsibility, governance, and technology

indicate that human-centered assumptions continue to organize ethical reasoning across academic, policy, and institutional contexts.

By empirically mapping the relational structure of bioethical concepts, the study clarifies how anthropocentrism functions not only as a normative orientation but also as a discursive architecture that stabilizes ethical meaning. Concepts related to non-human life and ecological concern are present in the discourse but remain structurally peripheral, limiting their capacity to influence the dominant configuration of ethical reasoning.

The findings contribute to discourse-based bioethical research by demonstrating the analytical value of semantic network analysis as a transparent and replicable methodological tool. Rather than relying solely on philosophical critique, this approach enables systematic assessment of conceptual centrality and mediation, thereby bridging normative bioethics and empirical discourse analysis.

Substantively, the study suggests that efforts to move beyond anthropocentrism in bioethics must address not only ethical principles but also the discursive structures through which responsibility and governance are articulated. Recognizing the structural prominence of human-centered semantics is a necessary step toward developing ethical frameworks that more effectively integrate ecological and non-human perspectives within contemporary governance debates.

References

- [1] Baker, P., Gabrielatos, C., KhosraviNik, M., Krzyżanowski, M., McEnery, T., & Wodak, R. (2008). A useful methodological synergy? Combining critical discourse analysis and corpus linguistics to examine discourses of refugees and asylum seekers in the UK press. *Discourse & Society*, 19(3), 273–306. <https://doi.org/10.1177/0957926508088962>
- [2] Beauchamp, T. L., & Childress, J. F. (2019). *Principles of biomedical ethics* (8th ed.). Oxford University Press.
- [3] Blok, A. (2013). Pragmatic sociology as political ecology: On the many worths of nature(s). *European Journal of Social Theory*, 16(4), 492–510. <https://doi.org/10.1177/1368431012473225>
- [4] Braidotti, R. (2013). *The posthuman*. Polity Press.
- [5] Callicott, J. B. (2013). *Thinking like a planet: The land ethic and the earth ethic*. Oxford University Press.
- [6] Carley, K. M. (1997). Network text analysis: The network position of concepts. In C. W. Roberts (Ed.), *Text analysis for the social sciences* (pp. 79–100). Lawrence Erlbaum.
- [7] Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). John Wiley & Sons.
- [8] Diesner, J. (2013). From texts to networks: Detecting and managing the impact of methodological choices for extracting network data from text data. *KNAW Workshop Proceedings*, 17, 75–88.
- [9] DiMaggio, P., Nag, M., & Blei, D. (2013). Exploiting affinities between topic modeling and the sociological perspective on culture: Application to newspaper coverage of U.S. government arts funding. *Poetics*, 41(6), 570–606. <https://doi.org/10.1016/j.poetic.2013.08.004>
- [10] Dryzek, J. S. (2013). *The politics of the earth: Environmental discourses* (3rd ed.). Oxford University Press.
- [11] Foucault, M. (1972). *The archaeology of knowledge* (A. M. Sheridan Smith, Trans.). Pantheon Books. (Original work published 1969)

- [12] Grunwald, A. (2014). Responsible innovation: Bringing together technology assessment, applied ethics, and STS research. *Enterprise and Work Innovation Studies*, 10, 9–31.
- [13] Hellsten, I., Dawson, J., & Leydesdorff, L. (2010). Implicit media frames: Automated analysis of public debate on artificial sweeteners. *Public Understanding of Science*, 19(5), 590–608. <https://doi.org/10.1177/0963662509343136>
- [14] Jasanoff, S. (2011). *Reframing rights: Bioconstitutionalism in the genetic age*. MIT Press.
- [15] Jonas, H. (1984). *The imperative of responsibility: In search of an ethics for the technological age*. University of Chicago Press.
- [16] Kopnina, H., Washington, H., Taylor, B., & Piccolo, J. J. (2018). Anthropocentrism: More than just a misunderstood problem. *Journal of Agricultural and Environmental Ethics*, 31(1), 109–127. <https://doi.org/10.1007/s10806-018-9711-1>
- [17] Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed.). Sage.
- [18] Latour, B. (2004). *Politics of nature: How to bring the sciences into democracy*. Harvard University Press.
- [19] Leydesdorff, L. (2007). Visualization of the citation impact environments of scientific journals: An online mapping exercise. *Journal of the American Society for Information Science and Technology*, 58(1), 25–38. <https://doi.org/10.1002/asi.20459>
- [20] Mol, A. P. J. (2002). Ecological modernization and the global economy. *Global Environmental Politics*, 2(2), 92–115. <https://doi.org/10.1162/15263800260047844>
- [21] Newman, M. E. J. (2010). *Networks: An introduction*. Oxford University Press.
- [22] Power, M. (2007). *Organized uncertainty: Designing a world of risk management*. Oxford University Press.
- [23] Salton, G., & McGill, M. J. (1983). *Introduction to modern information retrieval*. McGraw-Hill.
- [24] Stirling, A. (2008). Opening up and closing down: Power, participation, and pluralism in the social appraisal of technology. *Science, Technology, & Human Values*, 33(2), 262–294. <https://doi.org/10.1177/0162243907311265>
- [25] Taylor, P. W. (1986). *Respect for nature: A theory of environmental ethics*. Princeton University Press.
- [26] Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge University Press.

Annex A

Semantic Coding Instrument for Bioethical Texts

Purpose

This instrument was used to identify and code anthropocentric, responsibility-related, and governance-oriented semantic elements in bioethical texts included in the corpus.

Instructions

Read each text segment carefully and indicate the presence of the concepts listed below. Multiple selections are permitted.

Text ID: _____

Source Type:

☐ Academic article

☐ Policy document

☐ Institutional report

☐ Other: _____

Section A. Anthropocentric Orientation

Indicate whether the text segment reflects a human-centered ethical perspective.

- ☐ Human interests prioritized over non-human entities
- ☐ Human agency framed as the primary moral subject
- ☐ Nature framed instrumentally or as a resource
- ☐ Explicit reference to human dignity, autonomy, or control
- ☐ No anthropocentric orientation identified

Section B. Responsibility

Indicate how responsibility is articulated in the text.

- ☐ Individual moral responsibility
- ☐ Institutional or governmental responsibility
- ☐ Technological or innovation-related responsibility
- ☐ Intergenerational responsibility
- ☐ Responsibility toward non-human life
- ☐ Responsibility not explicitly addressed

Section C. Governance and Regulation

Indicate governance-related concepts present in the text.

- ☐ Policy-making and regulation
- ☐ Risk management and oversight
- ☐ Ethical committees or advisory bodies
- ☐ Democratic participation or deliberation
- ☐ Governance not addressed

Annex B

Semantic Association and Co-Occurrence Instrument

Purpose

This instrument was used to identify semantic co-occurrences among key ethical concepts for network construction.

Instructions

Mark the conceptual associations explicitly or implicitly present in the text segment.

Text ID: _____

Core Concept Identification

Select the concept most central to the text segment.

- ☐ Anthropocentrism
- ☐ Responsibility
- ☐ Governance
- ☐ Sustainability
- ☐ Technology
- ☐ Ecology
- ☐ Non-human life
- ☐ Other: _____

Conceptual Associations

Indicate all semantic associations observed.

- ☐ Anthropocentrism ↔ Responsibility
- ☐ Anthropocentrism ↔ Governance
- ☐ Anthropocentrism ↔ Technology

- ☐ Responsibility ↔ Governance
- ☐ Responsibility ↔ Sustainability
- ☐ Governance ↔ Risk
- ☐ Ecology ↔ Ethics
- ☐ Non-human life ↔ Moral consideration
- ☐ No clear associations identified

Annex C

Ethical Orientation Scale (Semantic Evaluation)

Purpose

This scale was used to assess the relative prominence of ethical orientations within each text segment.

Instructions

Indicate the degree to which each statement is reflected in the text.

Statement	Strongly Present	Moderately Present	Weakly Present	Not Present
Human welfare is the primary ethical criterion	☐	☐	☐	☐
Ethical responsibility is framed institutionally	☐	☐	☐	☐
Non-human entities are attributed intrinsic moral value	☐	☐	☐	☐
Long-term ecological consequences are emphasized	☐	☐	☐	☐
Ethical decision-making relies on governance mechanisms	☐	☐	☐	☐

Annex D

Validation and Reliability Checklist

Purpose

This checklist documents procedures used to ensure coding reliability and methodological transparency.

- ☐ Coding categories clearly defined
- ☐ Coding instructions consistently applied
- ☐ Multiple coders involved in semantic annotation
- ☐ Inter-coder agreement assessed
- ☐ Discrepancies discussed and resolved
- ☐ Final coding dataset validated for analysis

How to Cite: Crespo J. E., Sepúlveda J. G. M., Ornelas R. M. R., Valdés J. H., Lirios C. G., Campas C. Y. Q. (2026). Semantic Network Analysis of Bioethical Discourses: Mapping Anthropocentrism, Responsibility, and Governance. *International Journal of Education, Society and Policy*, 1(3), 74-83 .
<https://ijesp.org/index.php/ijesp/article/view/39>