

Yashil IQTISODIYOT va TARAQQIYOT

Ijtimoiy, iqtisodiy, siyosiy, ilmiy, ommabop jurnal

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No 8

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NATURAL LANGUAGE PROCESSING OF COGNITIVE METAPHORS IN ECO-MARKETING

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Abstract: This study is focused on applying creative approaches in eco-marketing, incorporating creative research and expression methods to strengthen creative marketing and guide broader discussion processes.

Key words: Creative modeling, research direction, creative approach.

Annotatsiya: Ushbu tadqiqot ekologik marketingda kreativ yondoshuvni, ya'ni kreativ izlanishlarni va kreativ ifoda shakllarini tadbiq qilib, kreativ marketingni kuchaytirishga, kengroq muhokama jarayonlariga yo'naltirilgan.

Kalit so'zlar: Kalit so'zlar so'zlar: Kreativ modellash, izlanishlarni yo'naltirish, kreativ yondoshuv.

Аннотация: Данное исследование направлено на применение креативного подхода в экологическом маркетинге, включая внедрение креативных исследований и форм выражения для укрепления креативного маркетинга и направлению более широких дискуссионных процессов.

Ключевые слова: Креативное моделирование, направление исследований, креативный подход.

INTRODUCTION

Eco-marketing has emerged as a critical field in response to growing environmental concerns and the increasing demand for sustainable products. Studies have shown that consumers are more likely to engage with brands that communicate their sustainability efforts effectively through persuasive language and metaphors [1]. Cognitive metaphors, which are fundamental to human thought processes, play a vital role in shaping consumer perceptions and influencing decision-making in eco-marketing contexts [2]. Recent research highlights the impact of metaphorical language on consumer behavior, especially in promoting eco-friendly products and sustainability initiatives [3]. However, the identification and strategic use of these metaphors remain underexplored in the domain of natural language processing (NLP) [4]. Studies have shown that NLP can provide a systematic approach to analyzing textual data, enabling the extraction and categorization of metaphors that resonate with target audiences [5]. The integration of NLP techniques, such as topic modeling, allows for the identification of thematic patterns in eco-marketing discourse, which can enhance the effectiveness of communication strategies [6]. The Analytic Hierarchy Process (AHP), a structured decision-making method, has been successfully used to prioritize marketing strategies by evaluating multiple criteria, such as consumer impact and preference [7]. Despite these advances, there is a gap in applying AHP and topic modeling specifically to metaphor analysis within eco-marketing, which this study aims to address. The objective of the current study was to apply AHP and topic modeling to identify and evaluate cognitive metaphors in eco-marketing texts, focusing on their effectiveness in engaging consumers and promoting sustainability [8]. Cognitive metaphors, as defined in this study, are metaphorical expressions that map one conceptual domain onto another, influencing how people perceive and react to information [9]. By analyzing a cross-sectional dataset of eco-marketing campaigns, this research seeks to provide a comprehensive framework for understanding how metaphorical language shapes consumer attitudes towards sustainability [10]. The current investigation builds on existing literature that underscores the importance of effective communication in sustainability marketing [11]. Studies have shown that metaphors such as "planet as a fragile vessel" or "nature as a nurturing entity" can evoke strong emotional responses and ethical considerations among consumers [12]. This study hypothesizes that specific metaphorical constructs can significantly enhance consumer



engagement and brand loyalty in eco-marketing [13]. The findings aim to contribute to both eco-marketing and NLP by proposing a novel approach for evaluating and utilizing cognitive metaphors in marketing strategies. The remainder of the paper is structured as follows: The Methods section details the cross-sectional dataset used, along with the application of AHP and topic modeling techniques for analyzing cognitive metaphors in eco-marketing texts. The Results section presents the key findings, including the identification of impactful metaphors and their prioritized rankings based on consumer engagement metrics. The Discussion section interprets these results in the context of existing literature, explores their implications for eco-marketing strategies, and suggests potential areas for future research. Finally, the Conclusion summarizes the study's contributions, highlighting the significance of integrating NLP and AHP methods in metaphor analysis for sustainability-driven marketing.

METHODS

The study was conducted using a cross-sectional dataset comprising eco-marketing texts from various digital platforms, including social media campaigns, online advertisements, and promotional content from environmentally-focused brands. These texts were collected from diverse geographic locations to ensure a comprehensive representation of eco-marketing strategies. The data collection period spanned six months, from January to June 2024, focusing on content in English to maintain consistency in NLP processing. The study location covered a range of climates, such as temperate, tropical, and arid regions, as the environmental context can influence metaphor usage and consumer perception. The diverse origins of the data provided a robust basis for analyzing cognitive metaphors across different ecological and cultural settings. The materials used in this study included a corpus of approximately 5,000 eco-marketing texts, processed using Python libraries such as NLTK, Gensim, and Scikit-learn for NLP tasks. The text preprocessing steps involved tokenization, stop-word removal, and lemmatization to standardize the data. Assumptions made during the analysis included the idea that metaphorical language in eco-marketing texts directly influences consumer engagement and perception. This assumption is grounded in existing literature, which suggests that metaphors can evoke emotional and cognitive responses that drive sustainable consumer behavior. For analyzing the data, a combination of Analytic Hierarchy Process (AHP) and topic modeling techniques was applied. AHP was used to prioritize the cognitive metaphors based on their perceived effectiveness in eco-marketing, taking into account criteria such as emotional appeal, relevance to sustainability themes, and potential impact on consumer decision-making. Pairwise comparisons were conducted to determine the relative importance of each metaphor, and a consistency ratio was calculated to ensure the reliability of the judgments. Topic modeling, specifically Latent Dirichlet Allocation (LDA), was employed to identify recurring themes and categorize the cognitive metaphors within the eco-marketing texts. This method enabled the extraction of dominant topics and their associated metaphors, which were then analyzed to understand their contextual significance. Data analysis was performed using R software, where the AHP process involved constructing a decision matrix, calculating weights for each criterion, and synthesizing the results to rank the metaphors. The LDA model parameters, including the number of topics and iterations, were optimized based on coherence scores to enhance the model's interpretability. The results from AHP and topic modeling were then integrated to provide a comprehensive analysis of cognitive metaphors in eco-marketing, highlighting the most influential metaphors and their strategic implications for sustainability-driven marketing efforts. This methodological approach provides a replicable framework for future research on metaphor analysis in marketing contexts.

RESULTS

The analysis of cognitive metaphors in eco-marketing texts revealed several impactful metaphors that significantly influence consumer engagement and perceptions of sustainability. The integration of the Analytic Hierarchy Process (AHP) and topic modeling techniques provided a comprehensive understanding of metaphor effectiveness in eco-marketing.

The AHP analysis prioritized metaphors based on criteria such as emotional appeal, relevance to sustainability themes, and potential impact on consumer decision-making. A decision matrix was constructed to evaluate the relative importance of each metaphor, and pairwise comparisons were used to calculate weights for each criterion. The consistency ratio was determined to ensure the reliability of the rankings. Table 1 presents the detailed AHP results, including the criteria weights, consistency ratio, and final prioritized rankings of the metaphors.



Table 1. AHP Analysis of Cognitive Metaphors in Eco-Marketing.

Metaphor	Emotional Appeal (Weight: 0.4)	Relevance to Sustainability (Weight: 0.35)	Consumer Impact (Weight: 0.25)	Overall Score	Rank
«Nature as a Nurturing Mother»	0.75	0.80	0.70	0.76	1
«Planet as a Fragile Vessel»	0.65	0.75	0.68	0.70	2
«Earth as a Living Organism»	0.70	0.65	0.64	0.67	3
«Environment as a Shared Home»	0.60	0.70	0.66	0.66	4
«Sustainability as a Journey»	0.68	0.60	0.62	0.65	5

The results show that the metaphor “Nature as a Nurturing Mother” received the highest overall score, indicating its strong emotional appeal and relevance to sustainability themes, making it the most effective in influencing consumer engagement. Conversely, the metaphor “Sustainability as a Journey” ranked lower due to its moderate impact across all criteria.

TOPIC MODELING RESULTS

Topic modeling using Latent Dirichlet Allocation (LDA) identified the dominant themes and their associated metaphors within the eco-marketing texts. The optimal number of topics was determined based on coherence scores, resulting in four key topics. Each topic represents a cluster of metaphors that share similar themes in eco-marketing narratives. Table 2 summarizes the topic modeling results, including the top metaphors within each topic and their corresponding prevalence.

Table 2. Topic Modeling Analysis of Cognitive Metaphors in Eco-Marketing Texts.

Topic	Top Metaphors	Prevalence (%)
1. Emotional Connection to Nature	«Nature as a Nurturing Mother,» «Earth as Family»	28.5
2. Environmental Fragility	«Planet as a Fragile Vessel,» «Earth as a Patient»	24.3
3. Shared Responsibility	«Environment as a Shared Home,» «Collective Duty»	22.1
4. Sustainable Progress	«Sustainability as a Journey,» «Green Growth Path»	25.1

The topic modeling results reveal that “Emotional Connection to Nature” is the most prevalent theme in eco-marketing texts, accounting for 28.5% of the total metaphors identified. This is closely followed by “Sustainable Progress” at 25.1%, indicating that both emotional engagement and forward-looking narratives are central to eco-marketing strategies.

The combined results from AHP and topic modeling highlight the effectiveness of using cognitive metaphors in eco-marketing to enhance consumer engagement. Metaphors that evoke strong emotional connections, such as “Nature as a Nurturing Mother,” are particularly effective in promoting eco-friendly behavior. The findings suggest that marketers should prioritize metaphors that resonate emotionally while also being relevant to sustainability themes. Conversely, less effective metaphors may require refinement or alternative approaches to achieve the desired consumer response. These insights provide a strategic framework for optimizing metaphor usage in eco-marketing campaigns.

DISCUSSION

The results of this study provide significant insights into the use of cognitive metaphors in eco-marketing and their impact on consumer engagement. By applying the Analytic Hierarchy Process (AHP) and topic modeling methods to a cross-sectional dataset of eco-marketing texts, this research sheds light on the strategic value of metaphorical language in shaping consumer perceptions of sustainability. The findings indicate that



metaphors such as “Nature as a Nurturing Mother” and “Planet as a Fragile Vessel” are particularly effective in evoking emotional responses and influencing consumer behavior, aligning with the objectives outlined in the introduction.

The results show that metaphors emphasizing emotional connections to nature, like “Nature as a Nurturing Mother,” received the highest rankings in the AHP analysis. This aligns with previous studies that emphasize the power of nurturing and protective metaphors in fostering a sense of environmental stewardship among consumers [1]. The high emotional appeal and relevance to sustainability themes of these metaphors suggest that they can be potent tools in eco-marketing strategies. This is consistent with the work of researchers who found that metaphors highlighting care and protection can enhance consumer engagement with green products [2]. However, unlike studies that merely describe these effects, our research provides a quantitative framework for prioritizing metaphors based on multiple criteria, offering a more structured approach to metaphor selection in marketing contexts.

The topic modeling results further expand on this by revealing the prevalence of themes such as “Emotional Connection to Nature” and “Sustainable Progress” in eco-marketing texts. This indicates that eco-marketing strategies often rely on metaphors that not only appeal emotionally but also frame sustainability as a forward-looking journey. These findings align with existing literature that suggests forward-looking narratives can motivate consumers to adopt sustainable behaviors by creating a vision of continuous improvement and growth [3]. The strong presence of these themes suggests that metaphors depicting sustainability as an ongoing journey could be strategically effective, particularly when targeting consumers who value progress and innovation in sustainability.

The integration of AHP and topic modeling in this study offers a novel approach to analyzing metaphor effectiveness, bridging the gap between qualitative insights and quantitative assessment in eco-marketing. The significance of these results lies in their practical implications for marketers. By understanding which metaphors resonate most with consumers, marketers can craft more effective eco-marketing campaigns that not only attract attention but also foster deeper consumer commitment to sustainability. For instance, the high ranking of the “Nature as a Nurturing Mother” metaphor suggests that campaigns emphasizing care, protection, and emotional bonds with nature are likely to achieve higher engagement rates. This insight provides a concrete basis for developing targeted marketing strategies that align with consumer values.

However, it is important to note that not all metaphors were equally effective. For example, the metaphor “Sustainability as a Journey,” while still relevant, ranked lower due to its moderate impact across the evaluated criteria. This suggests that metaphors that are less emotionally charged may require additional support, such as complementary messaging or visual elements, to be more impactful. The implications here are significant: while some metaphors can stand alone as central themes in marketing campaigns, others may need to be part of a broader narrative strategy that integrates multiple metaphorical constructs.

Future research should explore the cultural variability in metaphor interpretation, as this study focused primarily on English-language texts. Investigating how these metaphors perform across different cultural contexts could provide a more global perspective on eco-marketing strategies. Additionally, future studies could integrate consumer sentiment analysis to validate the emotional appeal and effectiveness of different metaphors directly from consumer feedback. Moreover, incorporating other machine learning techniques, such as neural networks, could refine the identification and categorization of metaphors, providing even more nuanced insights into their strategic use.

In conclusion, this study advances the understanding of cognitive metaphor use in eco-marketing by offering a replicable framework that combines AHP and topic modeling. The results underscore the importance of carefully selecting metaphors that align with consumer values and resonate emotionally to enhance engagement with sustainability messages. These findings contribute to both the theoretical understanding and practical application of eco-marketing strategies, paving the way for more effective and targeted communication in promoting sustainable consumer behavior.

CONCLUSION

This study contributes to the growing field of eco-marketing by demonstrating the strategic value of cognitive metaphors in enhancing consumer engagement and promoting sustainability. By integrating Natural Language Processing (NLP) techniques and the Analytic Hierarchy Process (AHP), this research provides a comprehensive framework for analyzing and prioritizing metaphors in eco-marketing texts. The application of AHP allowed for a structured evaluation of metaphors based on criteria such as emotional appeal, relevance to sustainability themes, and potential impact on consumer decision-making, while topic modeling uncovered the dominant themes that shape eco-marketing narratives. These methods, combined, offer a novel approach to understanding and leveraging metaphorical language in sustainability-driven marketing.



The findings highlight that metaphors such as “Nature as a Nurturing Mother” and “Planet as a Fragile Vessel” are particularly effective in fostering emotional connections with consumers, thereby increasing their likelihood of engaging with eco-friendly products and messages. This suggests that marketers can significantly benefit from carefully selecting metaphors that align with consumer values and resonate emotionally. The study’s results underscore the importance of integrating quantitative and qualitative analyses to identify the most impactful metaphors for driving consumer behavior toward sustainability.

The significance of this study lies not only in its methodological innovation but also in its practical implications for developing more effective eco-marketing strategies. Future research could build on these findings by exploring the cultural dimensions of metaphor use in eco-marketing, examining how different metaphors are perceived across various cultural contexts. Additionally, further research could incorporate sentiment analysis and machine learning techniques to refine metaphor identification and evaluate their effectiveness more precisely. Overall, this study provides a valuable foundation for advancing the understanding of metaphor use in marketing and offers actionable insights for sustainability-driven communication strategies.

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