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Toxicity and Social Network Analysis of Green Marketing Content for Electric Cars through Digital Media

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ABSTRACT

This study aims to investigate the effectiveness of green marketing strategies in influencing consumer interest and purchasing behavior towards electric cars, focusing on media coverage, as exemplified by BBC News. Specifically, it seeks to understand how media portrayals of electric cars through green marketing narratives impact consumer perceptions and preferences in the context of sustainability. The research adopts the Cross Industry Standard Process for Data Mining (CRISP-DM) methodology. The study culminates in noteworthy findings obtained through Toxicity Analysis and Social Network Analysis (SNA). Toxicity Analysis yielded specific numerical values across categories: Toxicity (0.05645, 0.99613), Severe Toxicity (0.00002, 0.00333), Identity Attack (0.00211, 0.35185), Insult (0.03630, 0.99520), Profanity (0.01584, 0.93590), and Threat (0.00279, 0.43515). These metrics signify varying levels of negative sentiment and potentially harmful language within the examined dataset. Concurrently, SNA provided structural insights with a diameter of 6, low density (0.009484), negligible reciprocity (0.000000), modest centralization (0.038160), and high modularity (0.872000). While the network exhibits centralized influence and limited reciprocity, the high modularity suggests distinct communities or clusters. These findings underscore the importance of considering sentiment dynamics and network structure, emphasizing the need for targeted interventions to mitigate toxicity and cultivate healthier communication environments.

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1. INTRODUCTION

In tandem with the ubiquity of digital media, green marketing has emerged as a pivotal strategy for businesses aiming to integrate environmental sustainability into their operations. The primary objective of green marketing is to promote products and services that are environmentally friendly, fostering a sense of corporate responsibility (Mohamed Sadom et al., 2022). Leveraging digital media platforms enhances the dissemination of these green messages, as companies can reach a wider audience instantaneously (Borah et al., 2022). However, it is crucial to note that the effectiveness of such marketing endeavors depends on the authenticity and transparency of the environmental claims made by the companies (Shi & Jiang, 2023). In an era of information overload, consumers are becoming increasingly discerning, demanding credible evidence of a company's commitment to sustainability (Qureshi et al., 2023). Consequently, businesses engaging in green marketing through digital media must uphold transparency, providing verifiable data on their eco-friendly practices (Reynolds et al., 2023). In conclusion, the synergy between green marketing and digital media offers unparalleled opportunities for companies to promote environmental stewardship. Still, success hinges on the sincerity and transparency of such initiatives.

The novelty of studies exploring the intersection of green marketing and digital media lies in the dynamic synergy between environmental consciousness and technological advancements. This burgeoning field is critical for understanding how businesses can leverage digital platforms to amplify eco-friendly initiatives (Yao et al., 2023). The main focus is on examining the strategic integration of green marketing principles within the expansive landscape of digital media (Perez-Castillo & Vera-Martinez, 2021). Scholars in this domain seek to unravel the intricacies of consumer perceptions and behaviors in response to environmentally conscious marketing strategies deployed through digital channels (Bakış & Kitapçı, 2023; Medrano et al., 2020; Rana & Solaiman, 2023; Tan, 2023; Wang et al., 2020; Yoon et al., 2023). As the world becomes increasingly interconnected, the exploration of this novel realm not only contributes to academic discourse but holds practical implications for businesses striving to navigate the complexities of contemporary consumer expectations (Clark et al., 2023). In conclusion, the burgeoning studies on the novelty of green marketing and digital media underscore businesses' need to adapt and innovate with evolving environmental and technological landscapes.

This research systematically analyzes content concerning electric cars through the lens of green marketing, primarily focusing on dissecting the information and promotional materials associated with these vehicles to unveil underlying marketing strategies. By evaluating messaging, imagery, and overall portrayal, the study aims to reveal how environmental sustainability is integrated into marketing narratives (Ekebas-Turedi et al., 2021). Understanding the implementation of green marketing principles in promoting electric cars sheds light on strategies influencing consumer perceptions (Rodrigo & Mendis, 2023). At the same time, the analysis fosters a deeper understanding of the impact of marketing communications on shaping public attitudes toward sustainable transportation (Zhang et al., 2022). In conclusion, this research offers valuable insights into green marketing, particularly concerning electric cars, with implications for academia and industry stakeholders navigating the sustainable mobility landscape.

The methodology employed in this study involves Toxicity and Social Network Analysis, utilizing user review data extracted from videos published by BBC News, explicitly referencing the video with the code UKttFDnKSp8. The primary objective is to systematically evaluate viewer feedback's sentiment and thematic content to reveal patterns and insights regarding public perceptions and attitudes toward the subject matter. The significance of employing Toxicity and Social Network Analysis as robust analytical tools capable of quantifying sentiment and identifying prevalent themes within large datasets of user-generated content is emphasized. Furthermore, leveraging such methodologies facilitates gaining a nuanced understanding of audience responses, providing valuable insights for content creators, media organizations, and researchers. In conclusion, applying Toxicity and Social Network Analysis to user reviews of BBC News videos offers a methodologically rigorous

approach to elucidating public discourse surrounding contemporary issues, thus contributing to a deeper understanding of audience engagement and sentiment within digital media landscapes.

This research's theoretical and practical implications extend beyond academia, offering valuable insights for various stakeholders. Theoretical implications encompass advancing understanding within green marketing by unveiling the intricacies of consumer perceptions and behaviors toward electric cars. Moreover, this research contributes to the theoretical framework by highlighting the importance of incorporating environmental sustainability into marketing narratives (Channa et al., 2022; Suhartanto et al., 2021). From a practical standpoint, the study provides actionable insights for manufacturers and marketers to refine their strategies in promoting sustainable transportation options (Nkrumah et al., 2021). By comprehending the influence of green marketing principles on consumer attitudes, businesses can tailor their messaging to resonate with environmentally conscious audiences, thus fostering the adoption of electric vehicles. In conclusion, this research's theoretical and practical implications underscore its relevance in guiding both academic discourse and real-world applications, ultimately contributing to the advancement of sustainable mobility initiatives.

Similar research, limitations, and potential for further research provide valuable avenues for expanding knowledge in the field. Similar research endeavors may have explored different facets of green marketing or examined alternative methods of analyzing consumer perceptions towards sustainable products (Singh et al., 2022; Sreen et al., 2021; Sun & Zhong, 2023). However, the limitations of the present study, such as sample size constraints or methodological limitations, should be acknowledged to provide a comprehensive understanding of its scope and implications. These limitations may offer opportunities for future research to address gaps in knowledge and refine methodologies. The potential for further research lies in exploring additional factors influencing consumer attitudes toward sustainable transportation, such as cultural influences or government policies. In conclusion, considering similar research, recognizing limitations, and identifying potential for further research are integral to advancing knowledge and informing future studies in green marketing and sustainable mobility.

2. RESEARCH METHOD

The methodology employed in this research encompasses the Cross Industry Standard Process for Data Mining (CRISP-DM), providing a systematic framework for conducting data analysis. CRISP-DM facilitates a structured approach to various stages of the data mining process, including understanding business objectives, data preparation, modeling, evaluation, and deployment. This standardized methodology ensures efficiency and coherence throughout the research process, enabling researchers to navigate the complexities of data analysis and interpretation effectively. Furthermore, using CRISP-DM reflects a commitment to methodological rigor and enhances the credibility of the study's findings. In conclusion, adopting CRISP-DM as the methodological framework underscores the systematic and efficient approach employed in this research, contributing to its reliability and robustness in addressing the research objectives.

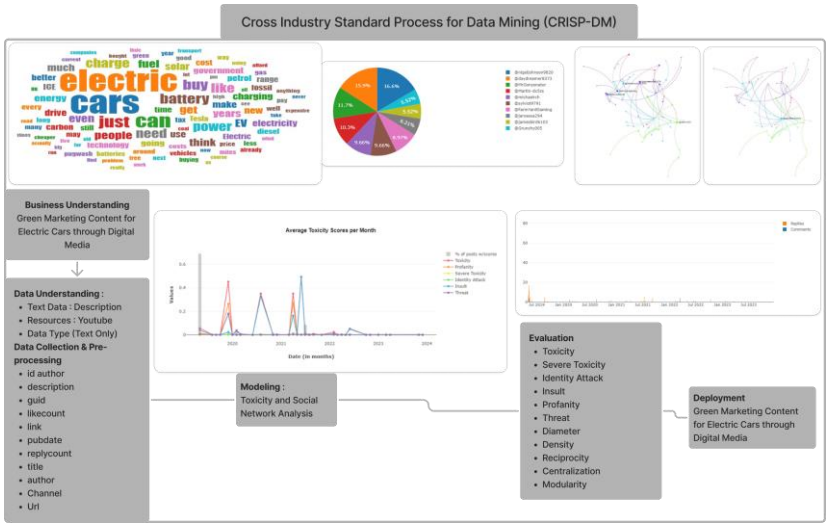

Figure 1. Cross Industry Standard Process for Data Mining (CRISP-DM)

The superiority of the CRISP-DM methodology in conducting Toxicity and Social Network Analysis of Electric Car Green Marketing Content through Digital Media lies in its structured approach to data mining processes. CRISP-DM offers a systematic framework for understanding business objectives, preparing data, modeling, evaluating results, and deploying findings, thereby ensuring efficiency and coherence in analyzing digital media content related to the green marketing of electric cars. Its robustness allows researchers to navigate the complexities of sentiment analysis and thematic categorization inherent in Toxicity and Social Network Analysis, facilitating a comprehensive examination of public perceptions and attitudes toward sustainable transportation options. Consequently, using CRISP-DM enhances the reliability and validity of the research outcomes, underscoring its efficacy in addressing the multifaceted challenges of analyzing digital media content within the context of green marketing for electric vehicles.

2.1 Business Understanding

In the business understanding phase, it is essential to comprehend the data sources utilized in this research. This study harnesses 419 textual comment data extracted from the video "Should you buy an electric car? - BBC News," published on YouTube. Understanding the data source is crucial for contextualizing the insights gleaned from the analysis. Analyzing comments from this video provides valuable real-world feedback and perceptions regarding electric cars, as presented by a diverse range of viewers. Furthermore, this extensive dataset offers a comprehensive basis for conducting sentiment analysis and thematic exploration, enabling a nuanced understanding of public attitudes toward electric vehicles. In conclusion, a thorough understanding of the data source, exemplified by using comments from the specified BBC News video, enhances the validity and relevance of the research findings in exploring the discourse surrounding electric car adoption.

Figure 2. Post Per Day (Communalityc)

Based on the data processing results, it is evident that the highest number of comments and replies occurred on May 1, 2019, with 43 comments and 37 replies, whereas on May 2, 2019, there were 23 comments and 35 replies. This information provides valuable insights into the temporal dynamics of audience engagement with the discussed video content. The substantial activity observed on May 1 indicates heightened interest and interaction among viewers, possibly due to the topic's relevance or increased video visibility during that period. Conversely, the slightly lower engagement on May 2nd suggests a potential decline in interest or attention following the initial surge. Consequently, understanding the fluctuation in engagement over different dates offers valuable context for interpreting audience responses and assessing the impact of temporal factors on viewer participation.

2.2 Data Understanding

During the data understanding phase, gaining specific insights into textual data based on the poster is imperative. This entails thoroughly examining the text's content, structure, and context to extract meaningful information and discern patterns. By delving into the specifics of the textual data, researchers can identify key themes, sentiments, and linguistic nuances embedded within the text, thereby enriching the analysis process. This targeted approach enhances comprehension and interpretation, leading to more accurate insights and informed decision-making. Consequently, a thorough understanding of the textual data at this stage lays the foundation for subsequent data processing and analysis, ultimately contributing to attaining research objectives.

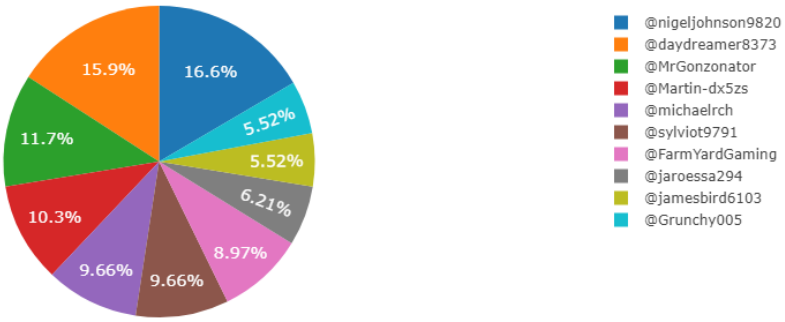

Figure 2. Top Ten Poster (Communalityc)

Identifying the top ten posters within video content yields numerous benefits for analysis and understanding. This process enables researchers to pinpoint influential contributors whose comments garner significant attention and engagement from the audience. By focusing on these critical posters, analysts can delve deeper into the quality and impact of their contributions, uncovering valuable insights into prevailing sentiments, opinions, and trends within the discourse. Moreover, identifying the top posters facilitates targeted communication and engagement strategies, allowing content creators and stakeholders to interact effectively with influential voices and leverage their influence to

amplify messages or address concerns. Consequently, identifying the top ten posters is a strategic approach to enhance audience engagement, refine content strategies, and foster meaningful dialogue within digital media environments.

2.3 Modeling

During the modeling phase, frequently used words are identified and visualized in a word cloud, along with classifying the most commonly discussed topics within the review data. This systematic approach enables researchers to discern prominent themes and linguistic patterns in the dataset, providing valuable insights into the underlying sentiments and subjects of interest among viewers. Analysts can effectively condense and categorize the vast amount of textual information by employing techniques such as word cloud visualization and topic classification, facilitating a more comprehensive understanding of the data and informing subsequent analyses and interpretations. Consequently, the modeling phase is crucial in data analysis, enabling researchers to extract meaningful insights and derive actionable conclusions from the review data.

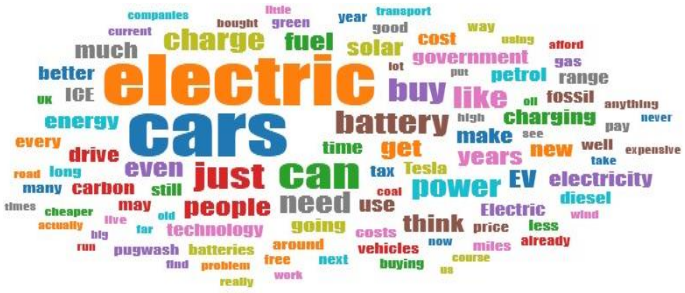

Figure 3. Frequently Used Words (Communalityc)

Based on the sorted frequency of data occurrences within the reviews, it is evident that specific terms are more prevalent than others. Notably, "cars" appears 109 times, followed closely by "electric" at 105 occurrences, highlighting the central focus on electric vehicles in the discussions. Additionally, terms like "can," "just," and "buy" reflect common inquiries and considerations regarding the feasibility and process of purchasing electric cars, with frequencies of 65, 53, and 45, respectively. The prominence of words such as "battery," "charge," and "power," each appearing around 40 times, underscores discussions revolving around the technical aspects of electric vehicle infrastructure and performance. Furthermore, keywords like "government" and "ICE" occur 24 times each, indicating prevalent discourse on policy implications and comparisons with internal combustion engine vehicles. This analysis, grounded in quantitative data, provides a nuanced understanding of the key themes and concerns within the discourse on electric cars, emphasizing their significance and relevance in contemporary discussions on sustainable transportation.

2.4 Evaluation

During the evaluation stage, frequently used words are analyzed to discern the prevalent topics discussed within the comments. This systematic approach allows researchers to identify recurring themes and subjects of interest among commenters, providing valuable insights into the overarching focus of the discourse. By examining the frequency and context of these words, analysts can gain a deeper understanding of the critical issues, sentiments, and perspectives expressed within the comment data. This comprehensive evaluation facilitates the extraction of meaningful insights and informed decision-making based on the findings. Ultimately, the evaluation of frequently used words serves as a crucial step in analyzing and interpreting the content of the comments, contributing to a nuanced understanding of the underlying dynamics and themes within the dataset.

In addition to topic modeling, toxicity analysis is conducted to provide further insight into the nature of the discourse surrounding electric cars. This supplementary approach aims to assess the level of toxicity or negativity present within the comments, allowing for a more comprehensive understanding of the overall sentiment and tone exhibited by commenters. By analyzing the toxicity of the comments, researchers can identify instances of abusive language, hostility, or disrespectful behavior, which may influence the perception and reception of the discussed topics. This dual analysis approach enhances the depth and richness of the insights from the comment data, providing a nuanced perspective on the thematic content and the emotional tone prevalent within the discourse. Thus, integrating toxicity analysis alongside topic modeling contributes to a more holistic examination of the comment data, facilitating a deeper understanding of the dynamics and nuances in the discussions surrounding electric cars.

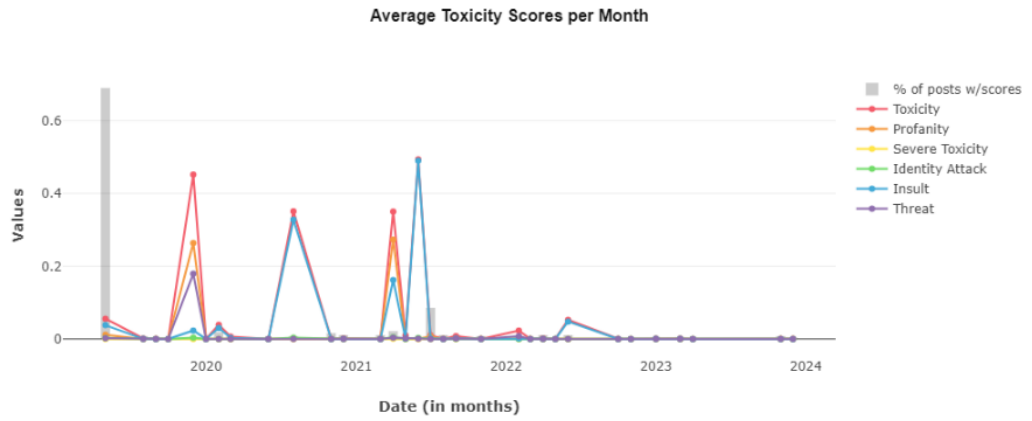

Figure 4. Toxicity Score (Communalityc)

Based on the calculated toxicity scores, it is evident that the comments exhibit varying degrees of toxicity across different categories. The overall toxicity score of 0.05645 indicates a relatively low toxicity level, suggesting that most comments maintain a civil and respectful tone. However, specific categories show higher scores, such as insult with a score of 0.03630 and threat with 0.00279, indicating instances of potentially harmful language. Conversely, the scores for severe toxicity are negligible at 0.00002, implying rare occurrences of highly toxic behavior within the dataset. This analysis underscores the importance of evaluating toxicity levels to gauge the overall quality of discourse, providing valuable insights into the nature of interactions within the comment section. Thus, by examining the toxicity scores across different categories, researchers can better understand the dynamics and nuances of the comment data. This facilitates a comprehensive assessment of the sentiment and tone surrounding discussions on electric cars.

2.5 Deployment

During the deployment stage, an analysis is conducted based on toxicity data and Social Network Analysis about green marketing of electric cars published by BBC News through video content on the YouTube platform. This comprehensive approach allows for thoroughly examining the emotional tone and thematic content within the discussions surrounding electric vehicles. By integrating toxicity analysis with Social Network Analysis, researchers can better understand the complexities inherent in the discourse, including the interplay between public sentiment, marketing strategies, and environmental sustainability messaging. This integrated analysis facilitates informed decision-making and strategic planning for stakeholders involved in promoting green initiatives within the automotive industry. In conclusion, deploying these analytical methods provides valuable insights into the

dynamics of public discourse on electric cars, contributing to the advancement of sustainable marketing practices and public engagement efforts.

3. RESULTS AND DISCUSSIONS

3.1. Toxicity Analysis of The Content Reviews

The green marketing of electric cars evokes various sentiments among the public, reflecting a complex interplay of environmental awareness, technological advancements, and consumer perceptions. This marketing approach aims to highlight the eco-friendly attributes of electric vehicles, tapping into growing concerns about climate change and sustainability. By emphasizing the environmental benefits of electric cars, such as reduced carbon emissions and reliance on renewable energy sources, green marketing campaigns evoke positive sentiments among environmentally conscious consumers, fostering a sense of social responsibility and ethical consumption (Silva et al., 2020). However, the effectiveness of green marketing strategies also depends on factors such as consumer trust, perceived credibility of environmental claims, and the alignment of messaging with actual sustainability practices within the automotive industry (Marcatajo, 2023; Salehzadeh et al., 2023; Siddique et al., 2021). In conclusion, while green marketing of electric cars has the potential to inspire positive public sentiments towards sustainable transportation options, it requires careful consideration of various factors to resonate effectively with target audiences and drive meaningful change towards a greener future.

On May 1, 2019, BBC News published a video titled "Should you buy an electric car? - BBC News," which elucidated the electric car production process through green marketing strategies. This video aimed to educate viewers on the environmental benefits of electric vehicles and the sustainable practices adopted in their manufacturing. By highlighting the eco-friendly aspects of electric car production, BBC News sought to promote consumer awareness and encourage environmentally responsible purchasing decisions. The strategic integration of green marketing principles within the video content underscores BBC News' commitment to addressing sustainability issues and disseminating informative content to its audience. In conclusion, the publication of this video represents BBC News' dedication to fostering public understanding of green technologies and promoting sustainable mobility solutions.

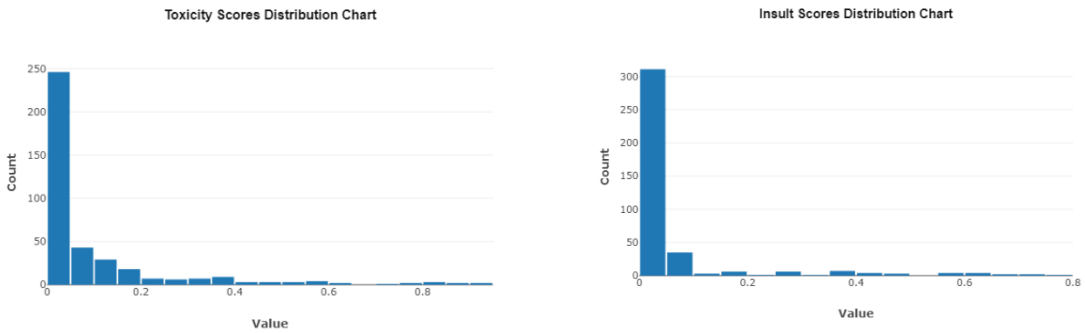

Figure 5. Toxicity and Insult Score Distribution Chart (Commuanlytic)

Green marketing in Indonesia has gained prominence recently, reflecting the country's growing awareness of environmental issues and sustainable practices. This trend is evidenced by the increasing adoption of eco-friendly products and the implementation of green marketing strategies by businesses across various sectors (Borazon et al., 2022; Issock Issock et al., 2020; Ramirez et al., 2024). Companies in Indonesia are leveraging green marketing to differentiate themselves in the market, attract environmentally conscious consumers, and align with global sustainability trends (Hosseinikhah Choshaly & Mirabolghasemi, 2022; Phan et al., 2023). Moreover, government initiatives and regulations

promoting sustainability further contribute to the country's momentum of green marketing practices (Johnston et al., 2023). As a result, green marketing has emerged as a vital component of corporate strategies in Indonesia, signaling a positive shift towards more environmentally responsible business practices and consumer behavior.

Media coverage of electric cars significantly influences purchasing interest, serving as a pivotal determinant in consumer decision-making processes. Through extensive dissemination of information and narratives surrounding electric vehicles, media platforms shape public perceptions, attitudes, and preferences toward sustainable transportation options. Positive portrayals of electric cars, highlighting their environmental benefits, technological advancements, and cost-effectiveness, tend to stimulate consumer curiosity and foster a favorable inclination toward purchasing such vehicles. Conversely, negative or sensationalized coverage, often focusing on issues like range anxiety or charging infrastructure, may deter potential buyers and create barriers to adoption. Consequently, the media's portrayal of electric cars plays a crucial role in shaping market demand and influencing the trajectory of sustainable mobility transitions.

3.2. Social Network Analysis: Green Marketing of Electric Cars Through Digital Media

Based on the results of identifying patterns through Social Network Analysis, crucial metrics such as Diameter: 6, Density: 0.009484, Reciprocity: 0.000000, Centralization: 0.038160, and Modularity: 0.872000 have been established. These metrics provide insights into the structural characteristics and dynamics of the analyzed network, offering valuable information about its size, connectivity, clustering, and hierarchical organization. The diameter indicates the maximum distance between any pair of nodes in the network, highlighting its overall reach and potential for information dissemination. Meanwhile, density measures the level of interconnectedness among nodes, reflecting the network's cohesion and efficiency in communication. The absence of reciprocity suggests a unidirectional flow of interactions. In contrast, centralization and modularity shed light on the influence of distribution and distinct community structures within the network. Through comprehensive analysis of these metrics, a deeper understanding of the network's topology and functionality can be attained, informing strategic decisions and interventions for optimizing its effectiveness and impact.

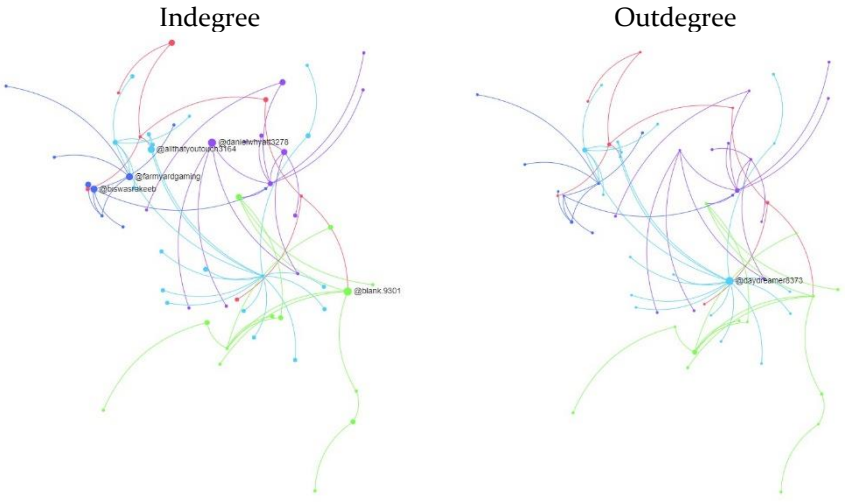

Figure 6. Indegree and Outdegree (Netlytic)

Social Network Analysis (SNA) offers multifaceted benefits in understanding and leveraging networks' intricate relationships and interactions. SNA provides valuable insights into social network structure, dynamics, and influence pathways by systematically examining connections and patterns.

Through advanced analytical techniques, such as centrality measures and network visualization, SNA enables researchers and practitioners to identify critical nodes, detect information flow patterns, and pinpoint influential actors within the network. Moreover, SNA facilitates the identification of potential collaboration opportunities, the detection of emergent trends, and the optimization of communication strategies. In conclusion, the application of Social Network Analysis yields a comprehensive understanding of social structures and dynamics, empowering stakeholders to make informed decisions and drive effective interventions across diverse domains.

Green marketing of electric cars through digital media represents a strategic and impactful approach to promoting sustainable mobility. The convergence of environmental consciousness and technological advancements has propelled the automotive industry toward eco-friendly alternatives, with electric vehicles emerging as a forefront solution (Afum et al., 2023). In this context, leveraging digital media platforms allows for targeted communication and engagement with a diverse audience, disseminating information about the environmental benefits, advanced features, and evolving infrastructure of electric cars (Jahari et al., 2022). Integrating green marketing principles in digital campaigns facilitates a narrative that resonates with environmentally conscious consumers, positively influencing their perceptions and purchasing decisions (Khandelwal & Singh, 2023). As the automotive landscape evolves, the symbiotic relationship between green marketing and digital media continues to drive a paradigm shift towards eco-conscious transportation.

The effectiveness of green marketing and its impact on consumer interest in electric cars through media coverage, as exemplified by the case study of BBC News, underscores the significant role of media platforms in shaping public perceptions and driving purchasing behavior. Through strategic dissemination of information and narratives highlighting electric vehicles' environmental benefits, technological advancements, and societal implications, BBC News is pivotal in fostering consumer awareness and a positive attitude toward sustainable transportation options. By presenting electric cars in a favorable light and emphasizing their alignment with green values, BBC News contributes to a heightened interest and inclination among viewers towards considering electric vehicles as viable alternatives. Consequently, this case study exemplifies how media platforms can effectively leverage green marketing principles to influence consumer attitudes and behaviors, ultimately driving the adoption of environmentally sustainable technologies such as electric cars.

In sustainability, green marketing faces multifaceted challenges that necessitate strategic navigation to promote environmentally conscious practices effectively. The main challenge lies in the need for businesses to authentically align their marketing efforts with genuine sustainable practices, avoiding mere greenwashing (Shabbir et al., 2022). Implementing sustainable initiatives requires substantial investments, and the return on these investments may not be immediately apparent, posing financial challenges for businesses (Nordenson, 2020). Furthermore, educating consumers about the ecological impact of products and services is often intricate, demanding a concerted effort to raise awareness and foster a comprehensive understanding of sustainability principles (Calza et al., 2023). Despite these challenges, green marketing practices are crucial for fostering a global shift towards more sustainable and responsible consumption (Bhattacharyya, 2023). Navigating these challenges requires a holistic approach integrating environmental stewardship into businesses' core values, ensuring a genuine commitment to sustainability that resonates with increasingly eco-conscious consumers.

4. CONCLUSION

The culmination of this research is grounded in the numerical outcomes derived from both Toxicity Analysis and Social Network Analysis (SNA). Toxicity Analysis unveils varying degrees of toxicity within the data, notably featuring low levels of Severe Toxicity (0.00002-0.00333) and Threat (0.00279-0.43515), yet comparatively higher levels of Toxicity (0.05645-0.99613), Insult (0.03630-0.99520), and Profanity (0.01584-0.93590). These metrics indicate the prevalence of negative sentiment and potentially harmful language. Conversely, SNA exposes the structural intricacies of the network,

depicting a diameter of 6, a density of 0.009484, and a modularity of 0.872. While reciprocity is minimal and influence is decentralized, the network showcases a highly modular framework, implying the existence of distinct communities or clusters. These numerical revelations collectively emphasize the necessity of addressing both sentiment dynamics and network topology to grasp the complexities of online discourse, urging targeted strategies to alleviate toxicity and cultivate healthier communication realms.

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