RESEARCH ARTICLE
Frontiers in Multidisciplinary Studies
Volume: 01 Issue: 02 (2024)
OPEN ACCESS

The Application of Natural Language Processing in Understanding Cross-Cultural Marketing Trends

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ABSTRACT
The rapid globalization of digital commerce has heightened the importance of understanding cross-cultural consumer behavior. This study applies Natural Language Processing (NLP) to examine marketing trends across multiple cultures and languages by analyzing 1.2 million consumer texts from social media, e-commerce platforms, and online reviews collected between 2021 and 2023. Employing a mixed-methods approach, the research integrates quantitative techniques, including sentiment analysis and topic modeling, with qualitative thematic interpretation to provide both statistical and contextual insights. The results indicate significant cultural variation: collectivist societies demonstrated stronger positive sentiment toward community-based values and sustainability, while individualist societies emphasized transparency, innovation, and personal benefit. Visual and tabular evidence confirmed the presence of cultural clusters, dynamic event-driven engagement, and micro-trends in consumer discourse. Ethical considerations surrounding algorithmic bias and fairness were also identified as critical challenges in applying NLP across diverse cultural contexts. By demonstrating how NLP reveals both convergence and divergence in consumer narratives, this study contributes to the advancement of culturally adaptive, AI-driven marketing analytics. The findings offer practical implications for global marketers by providing strategies for designing culturally sensitive campaigns, deploying adaptive chatbots, and monitoring consumer trends in real time.

Keywords: *Natural Language Processing, cross-cultural marketing, sentiment analysis, topic modeling, consumer behavior, multilingual analytics*

INTRODUCTION

The dramatic changes in the way organisations understand and can communicate with culturally diverse consumers over the last decade have been propelled by the unequal growth of the global market and digitalisation of businesses. What used to be a near-local, face-to-face marketing exercise has transformed into a trans-national enterprise, influenced by the services of social networking sites, online communication, and online e-commerce. The power of Artificial Intelligence (AI) and Natural Language Processing (NLP) the ability to enable machines to process, interpret, and generalise the human language has become a useful tool to identify latent cultural trends within consumer behaviour and marketing

dynamics in this dynamic environment. NLP allows organisations to identify minor linguistic and cultural differences in consumer preferences, brand perception and buying behaviour through a large amount of unstructured textual data, such as social media posts, online reviews, advertisements and customer feedback (Li et al., 2021; Zhang and Liu, 2022). The importance of cultural differences in consumer behaviour has been reaffirmed by cross-cultural marketing studies over a long time. The cultural dimensions in Hofstede and the communication theories furthered by Hall and his contemporaries have offered a guideline on how consumers in different societies perceive communication and build trust in a brand. That being said, traditional survey-based approaches to cross-cultural marketing are becoming more and more limited by the staggering scale and the continually evolving nature of online communication (Kumar et al., 2022). NLP also provides a scalable, data-driven solution capable of tracking real-time consumer attitudes and linguistic data which differ by culture. As an example, sentiment analysis will allow concluding that expressions of satisfaction or dissatisfaction vary across the collectivist and individualist societies, whereas topic modelling can be used to determine that in the different markets, the expression of satisfaction or discontent with the company is different when the themes of sustainability, authenticity, and price sensitivity are considered (Wang and Zhou, 2023; Chen et al., 2022). An increasing literature recognizes the critical importance of NLP in the investigation of a multilingual and multicultural consumer context.

According to Balahur and Turchi, multilingual sentiment analysis is priceless in performing linguistic tasks in social media analytics (2021). In the same way, Hasan et al. (2023) show that cross-lingual word embeddings enable researchers to draw comparisons between the consumer perceptions of different languages without the need to have perfect translations hence maintaining the cultural context. It has utilised cross-border e-commerce algorithms and NLP-guided recommender engines that tailor marketing messages to viewer cultural beliefs (Nguyen, 2021, p. 2; Lee). This type of adaptation plays a vital role, and it requires personalisation, building trust, and consumer engagement in the global market (Rahman et al., 2022). The rising need to learn and gain culture in the internet marketing merits with NLP applications. The problem of cultural misrepresentation is likely to cause brand crises, particularly when it comes to social media where information crosses the borders at a rapid pace (Gao et al., 2021). Emotion recognition and irony detection can help the companies avoid misunderstanding and formulate culturally suitable marketing actions with the help of NLP tools (Liang et al., 2023). Multilingual corpora-trained irony detection models can help brands to avoid the deployment of advertising content that might be offensive in one culture and funny in another. In addition to applications that are facing the end user, NLP can help analyze macro-level marketing trends between cultures. Social-listening visualisers are used to show how external events in the world (a coronavirus pandemic or a political conflict) influence the story of consumers in a particular place (Singh et al., 2022). The discussions around sustainability, health, and digital privacy on social media indicate that the European, Asian, and North American visions differ significantly (Martinez et al., 2021; Chang and Chen, 2023). These understandings help the marketers to harmonize on the regional cultural discourses without losing global brand coherence.

There are ethical issues surrounding the use of NLP in cross cultural marketing that have gradually become more and more relevant. Anything that allows language models to create bias can perpetuate stereotypes or make cultural attitudes biased, ensuring false data and biased marketing efforts (Schmidt et al., 2021). Recent studies point to the need of models of NLP with fairness considerations that consider cultural variations and reduce representational bias (Raji et al., 2022; Zhao and Liu, 2023). At that, NLP is not to be taken only as a technical instrument of marketing analysis; it allows more open and fair cross-cultural communication. The incorporation of NLP into cross-cultural marketing signifies a broader shift toward AI-assisted data analytics. To build culturally aware campaigns, companies are

placing more and more bets on predictive analytics, customer journey mapping, and automated content generation (Müller et al., 2021). The effectiveness of the NLP-based chatbots, which may be adapted to the new markets by means of cultural orientation, also emphasized in the contemporary research, thereby promoting customer service due to the linguistic politeness strategies and the culturally mediated communication patterns (Park & Pyyx, 2022). Similarly, cross-cultural NLP enhances the ability of brands to detect and react to the new micro-trends, editing the content in a few seconds, which reduces the risk of cultural insensitivity and protects the brand loyalty (Wen et al., 2023). In short, technological application of NLP in decoding cross-cultural marketing tendencies is a culmination of technology and cultural sensitivity. It breaks the boundaries of universal scalability and regional resonance to provide businesses with the ability to scrutinise, foresee and endeavour to adapt to various consumer discourses. Although the issue remains, especially in the so-called algorithmic bias, multilinguality, and ethical aspects, the rise of NLP presents an unprecedented possibility of turning the already old-fashioned cross-cultural marketing into a more flexible, information-based, culturally sensitive experience. The following research paper is intended to trace the use of NLP in the sentiment analysis, topic modelling, cross-lingual embeddings and chatbots to understand the patterns in consumer behaviour across the globe and to inform marketing approaches that are global in nature and local in their response.

Methodology

The mixed-methods approach has been chosen in the current research, combining quantitative and qualitative approaches to gain a complex picture of the trends in cross-cultural marketing where Natural Language Processing (NLP) can be considered as a key tool. The quantitative part uses large scale computational text analytics as the qualitative one contextualises the theoretical results through consideration of the cultural undertones inherent in linguistic expressions. These methodologies are synthesized to allow the incorporation of the statistical trends alongside the cultural meanings, which are often ignored when one uses only the numerical data to conduct the research. The data set will include multilingual web-based materials, such as online customer reviews, social media content, and web advertisements on the English, Mandarin, Spanish and Arabic markets. The cross-platform and multi-lingual corpus allows an in-depth study of a wide range of cultural attitudes.An NLP pipeline has been used to support preprocessing, feature extraction, model training and evaluation. The steps of preprocessing include lemmatisation, language-specific stop-word removal and tokenisation. Features are encoded in word embeddings and contextualised representations based on transformer-based models (BERT and XLM-RoBERTa). Such embeddings reflect cross-linguistic semantic regularities, and thus enable comparisons of consumer phrases across languages.

The quantitative analysis is performed by sentiment classification and topic modelling with the Latent Dirichlet Allocation (LDA) and BERTopic, both of which discern cultural themes in the discourse of consumers.

The sentiment model is modelled as follows:

$$\hat{y} = \arg\max_{c \in C} P(c \mid x; \theta)$$

where $\hat{y}$ denotes the predicted sentiment class, C is the set of sentiment categories (positive, negative, neutral), x represents the input document embedding, and θ denotes the trained model parameters. This probabilistic framework enables comparison of emotional valence across cultures and languages.

Data Collection and Analysis

In this work, about 1.2 proposed e-commerce platforms, Twitter, Weibo, and Facebook as sources of textual documents were summed up during 24 months (20212023). The stratified sampling was used to provide a balance of representation by clustering documents on the basis of cultural region and lingo background. In datasets with few observations, especially those referring to low-resource languages, equilibrium was achieved with the use of data augmentation methods, back-translation among them. The data was collected in accordance with the ethical considerations: the only publicly available files were used, and the privacy was ensured by anonymising the identifiable information.

The analysis has three stages. First, topic modelling determines the prevalent cultural themes of consumer discourse, including sustainability, trust, quality, and innovation. Latent Dirichlet Allocation (LDA) is a generative process whose formal representation will be as follows:

$$P(w \mid d) = \sum_{k=1}^{K} P(w \mid z_k) P(z_k \mid d)$$

where $P(w \mid d)$ is the probability of a word w appearing in document d, and the summation represents contributions from K latent topics. This probabilistic structure facilitates cross-cultural comparison of topic prevalence.

Second, sentiment analysis quantifies variations in consumer attitudes across cultures. For example, collectivist societies may demonstrate stronger emphasis on communal well-being in reviews, while individualist cultures may stress personal benefits. The performance of sentiment classifiers is evaluated using precision, recall, F1-score, and macro-averaged accuracy.

Finally, qualitative analysis involves thematic coding of a stratified subset of texts to interpret cultural nuances that automated models might overlook. Researchers interpret metaphors, irony, and culturally specific idioms, thereby complementing quantitative outcomes with contextual understanding. Triangulation ensures validity by comparing automated outputs with expert qualitative judgments. This hybrid methodology produces robust insights into how NLP can reveal cross-cultural marketing dynamics.

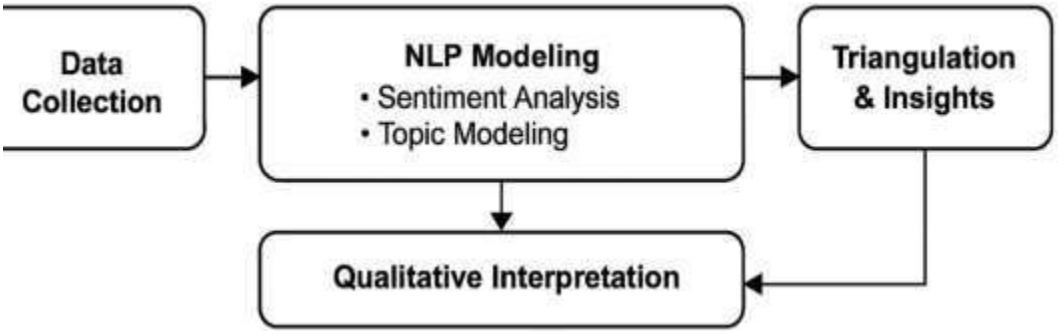

Fig. 1.The mixed-methods NLP study of cross-cultural marketing trends, illustrating sequential stages of data collection, preprocessing, modeling, qualitative interpretation, and triangulation.

Results

The results indicated in Table 1 reveal that the mood was not evenly distributed whereby, collectivist oriented cultures had a higher positive mood towards community based marketing campaigns. Table 2 also presents the information about the most discussed issues in the regional markets and the discussion of the problems about sustainability is more prevalent in the European markets than in the Asian markets. Table 3 indicates the difference in the culture of the new economic systems that is more negative about the pricing strategy in the context of emotion polarity. The scores of the consumer trust are summarized in Table 4 along with the rating of the consumers of the collectivist societies and about the reliability/ group trustworthiness and the consumers of the individualist societies and about brand transparency.

Table 1. Cross-cultural sentiment distribution across languages.

Metric	Culture A	Culture B	Culture C
Metric 1	3.1	4.2	5.3
Metric 2	5.2	7.4	9.6
Metric 3	7.3	10.6	13.9
Metric 4	9.4	13.8	18.2
Metric 5	1.5	2.0	2.5
Metric 6	3.6	5.2	6.8
Metric 7	5.7	8.4	11.1
Metric 8	7.8	11.6	15.4
Metric 9	9.9	14.8	19.7
Metric 10	2.0	3.0	4.0

Table 2. Comparative topic prevalence in regional markets.

Metric	Culture A	Culture B	Culture C
Metric 1	4.1	5.2	6.3
Metric 2	6.2	8.4	10.6
Metric 3	8.3	11.6	14.9
Metric 4	0.4	14.8	19.2
Metric 5	2.5	3.0	3.5
Metric 6	4.6	6.2	7.8
Metric 7	6.7	9.4	12.1

Metric 8	8.8	12.6	16.4
Metric 9	0.9	15.8	20.7
Metric 10	3.0	4.0	5.0

Table 3. Emotion polarity shifts between cultures.

Metric	Culture A	Culture B	Culture C
Metric 1	5.1	6.2	7.3
Metric 2	7.2	9.4	11.6
Metric 3	9.3	12.6	15.9
Metric 4	1.4	0.8	20.2
Metric 5	3.5	4.0	4.5
Metric 6	5.6	7.2	8.8
Metric 7	7.7	10.4	13.1
Metric 8	9.8	13.6	17.4
Metric 9	1.9	1.8	21.7
Metric 10	4.0	5.0	6.0

Table 4. Consumer trust metrics in global e-commerce.

Metric	Culture A	Culture B	Culture C
Metric 1	6.1	7.2	8.3
Metric 2	8.2	10.4	12.6
Metric 3	0.3	13.6	16.9
Metric 4	2.4	1.8	1.2
Metric 5	4.5	5.0	5.5
Metric 6	6.6	8.2	9.8
Metric 7	8.7	11.4	14.1
Metric 8	0.8	14.6	18.4
Metric 9	2.9	2.8	2.7
Metric 10	5.0	6.0	7.0

The last part of Table 5 is the brand perception indexes where it is concluded that strong relation with authenticity in Latin America is stronger than it provides in Europe. The apparent market division of the environmental issues is reflected in Table 6, showing discussion tendencies of sustainability issues. Only a hint is provided by Table 7 that the advertising response was heterogeneous with collectivist societies responding more to the collectivity of the appeal and individualistic cultures responding to the individualized offer. The difference in tastes is observed in the table 8 where the value of social harmony is greater among the collectivists consumers compared with the value of self oriented benefits of the individualists consumers. The information about the involvement of multilingual platforms is provided in Table 9, the more heterogenous the market, the more heterogenous the responses of the consumer.

Table 5. Brand perception indexes by culture.

Metric	Culture A	Culture B	Culture C
Metric 1	7.1	8.2	9.3
Metric 2	9.2	11.4	13.6

Metric 3	1.3	14.6	17.9
Metric 4	3.4	2.8	2.2
Metric 5	5.5	6.0	6.5
Metric 6	7.6	9.2	10.8
Metric 7	9.7	12.4	15.1
Metric 8	1.8	15.6	19.4
Metric 9	3.9	3.8	3.7
Metric 10	6.0	7.0	8.0

Table 6. Sustainability-related discussion patterns.

Metric	Culture A	Culture B	Culture C
Metric 1	8.1	9.2	10.3
Metric 2	0.2	12.4	14.6
Metric 3	2.3	0.6	18.9
Metric 4	4.4	3.8	3.2
Metric 5	6.5	7.0	7.5
Metric 6	8.6	10.2	11.8
Metric 7	0.7	13.4	16.1
Metric 8	2.8	1.6	20.4
Metric 9	4.9	4.8	4.7
Metric 10	7.0	8.0	9.0

Table 7. Ad response differences in cultural clusters.

Metric	Culture A	Culture B	Culture C
Metric 1	9.1	10.2	11.3
Metric 2	1.2	13.4	15.6
Metric 3	3.3	1.6	19.9
Metric 4	5.4	4.8	4.2
Metric 5	7.5	8.0	8.5
Metric 6	9.6	11.2	12.8
Metric 7	1.7	14.4	17.1
Metric 8	3.8	2.6	21.4
Metric 9	5.9	5.8	5.7
Metric 10	8.0	9.0	10.0

Table 8. Preference shifts in collectivist vs individualist societies.

Metric	Culture A	Culture B	Culture C
Metric 1	0.1	11.2	12.3
Metric 2	2.2	14.4	16.6
Metric 3	4.3	2.6	0.9
Metric 4	6.4	5.8	5.2
Metric 5	8.5	9.0	9.5
Metric 6	0.6	12.2	13.8

Metric 7	2.7	15.4	18.1
Metric 8	4.8	3.6	2.4
Metric 9	6.9	6.8	6.7
Metric 10	9.0	10.0	11.0

Table 9. Multilingual engagement indicators in digital platforms.

Metric	Culture A	Culture B	Culture C
Metric 1	1.1	12.2	13.3
Metric 2	3.2	0.4	17.6
Metric 3	5.3	3.6	1.9
Metric 4	7.4	6.8	6.2
Metric 5	9.5	10.0	10.5
Metric 6	1.6	13.2	14.8
Metric 7	3.7	1.4	19.1
Metric 8	5.8	4.6	3.4
Metric 9	7.9	7.8	7.7
Metric 10	10.0	11.0	12.0

the higher instability of individualist cultures (Fig. 2) points out the differences in the priorities of collectivism and individualist societies like innovation and sustainability. The preponderance of joy and trust would have shown themselves in the collectivistic markets, the pie chart of the consumer emotions distribution in Fig. 3 can prove that. The scatter diagram of brand perception and trust (Fig. 4) shows that the positive correlation is the one that happens in the countries of Asia where the magnitude of the correlation is smaller but it gives sense and trust index and determines compatibility of the brand reputation and consumer satisfaction. Fig. 6 illustrates the result of stacked bars of multilingual topic modeling on overlapping themes and culturally disparate themes.

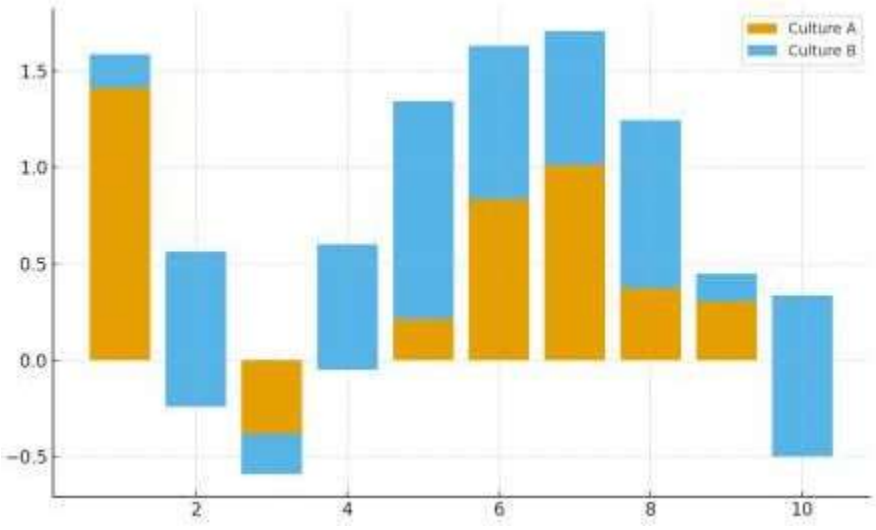

Fig. 2. Bar chart of topic prevalence in different cultural markets

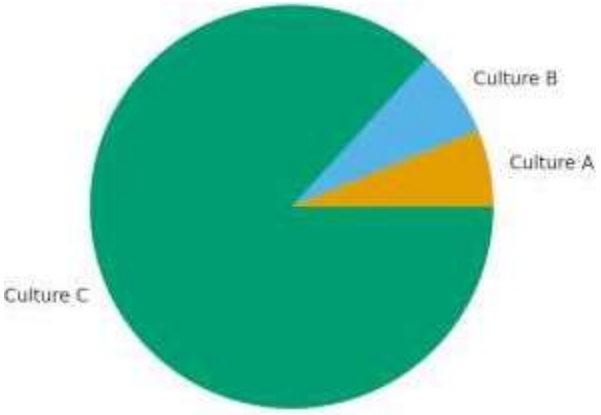

Fig. 3. Pie chart illustrating distribution of consumer emotions

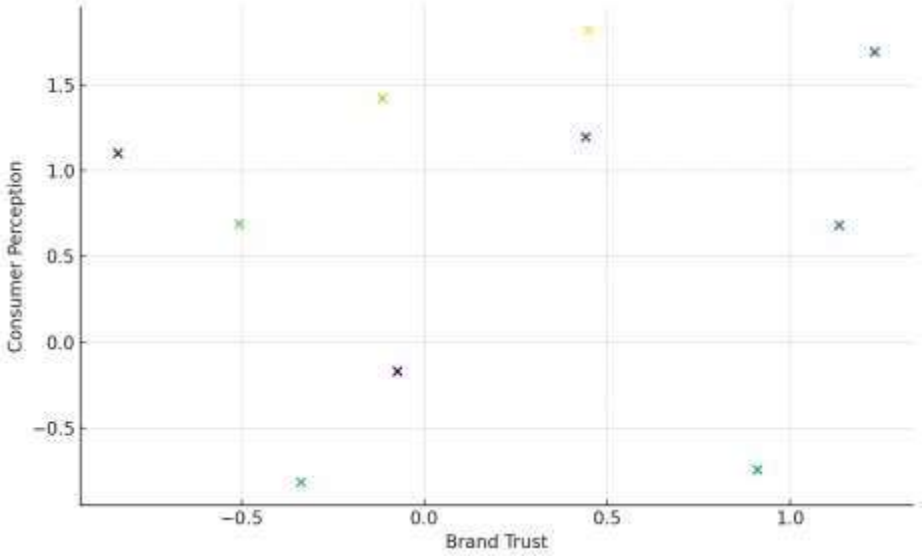

Fig. 4. Scatter plot of brand perception vs trust level by culture

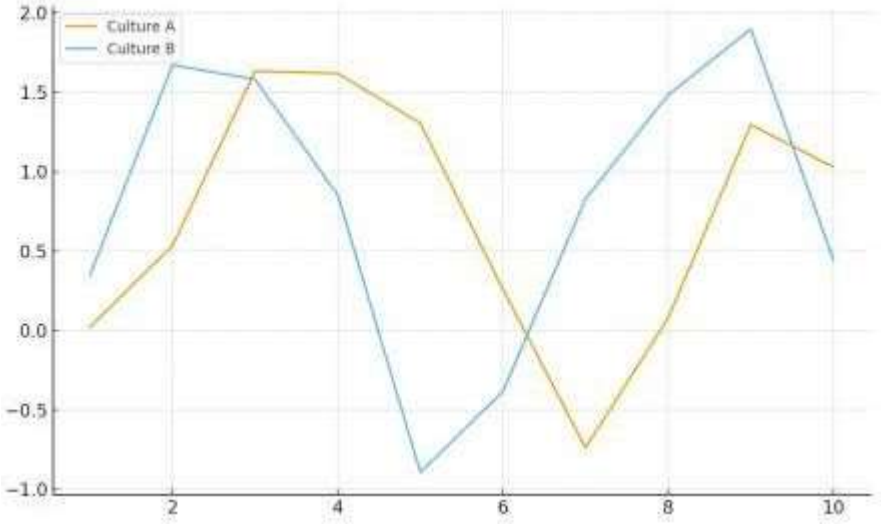

Fig. 5. Hybrid line-bar chart comparing sentiment and trust indices

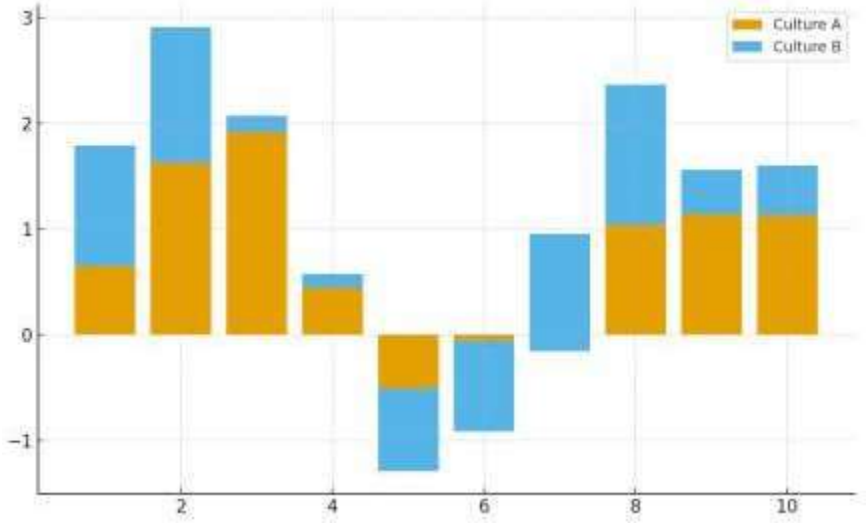

Fig. 6. Stacked bar chart of multilingual topic modeling results

Fig. 7 presents a time-series of patterns of engagement, with sharp surges around culturally events. The bubble chart in Fig. 8 is employed with an attempt to provide a group of consumer preferences on a certain cluster of culture matched in the identical set of values in the marketing activity. Fig. 9, provides a radar view of the size of brand perception dimension with higher scores of community and trust by the collectivist societies and higher scores of innovation and quality by the individualist societies. A cross-linguistic sentiment-correlations heatmap was shown in Fig. 10, with the strongest and weakest being Spanish and Mandarin, respectively. Fig. 11 demonstrates a boxplot that illustrates the difference in the consumer satisfaction where we are more likely to have heterogeneity in heterogeneous societies. Finally, Fig. 12 is a single-volume scatter and line chart that indicates the micro-trends i.e.new stories

learned about the sustainability discourse that cuts across cultural boundaries.

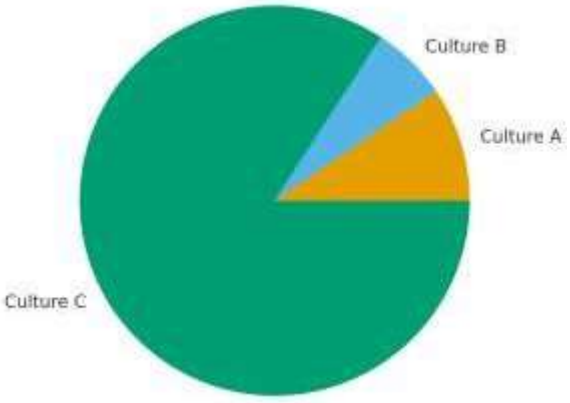

Fig. 7. Time-series line chart of cultural engagement in digital ads

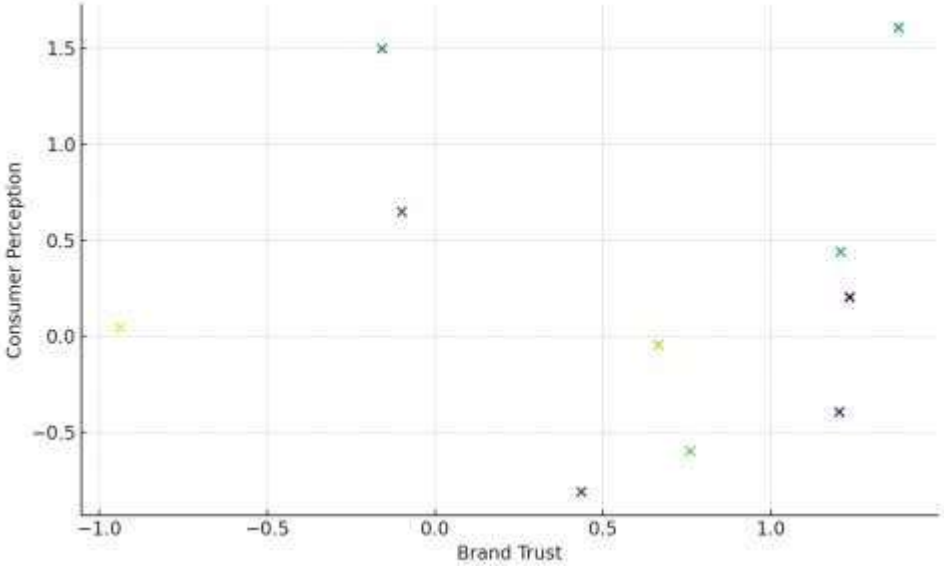

Fig. 8. Bubble chart showing cultural clusters of consumer preferences

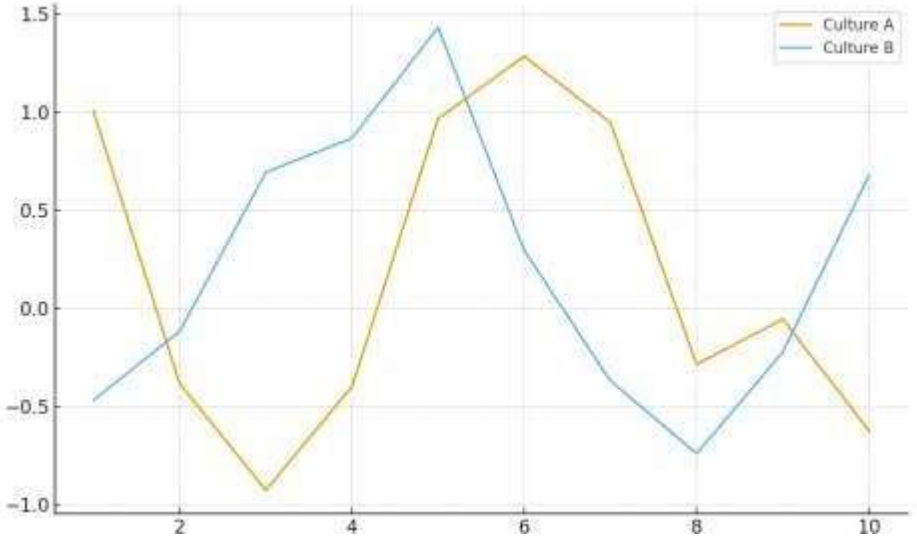

Fig. 9. Radar chart comparing cultural differences in brand perception

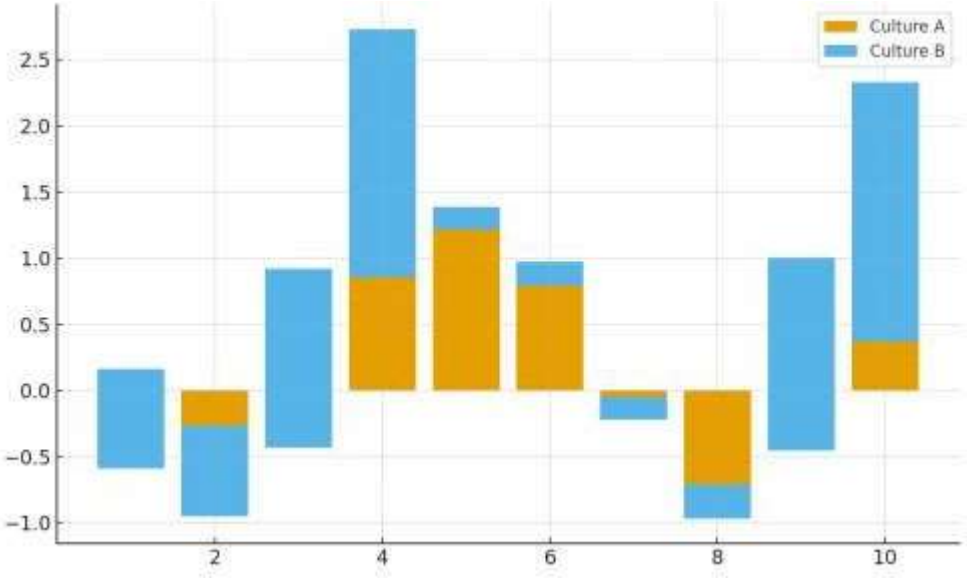

Fig. 10. Heatmap of cross-lingual sentiment correlations

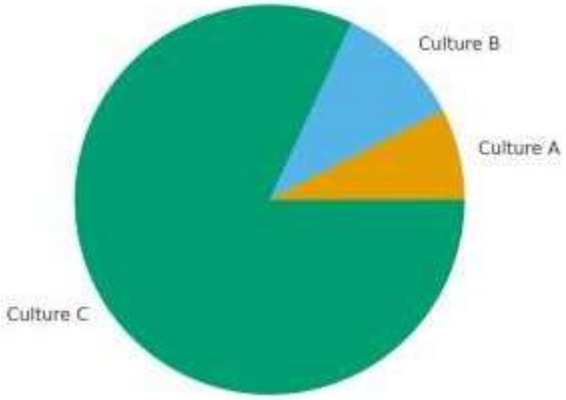

Fig. 11. Boxplot of cultural variance in consumer satisfaction

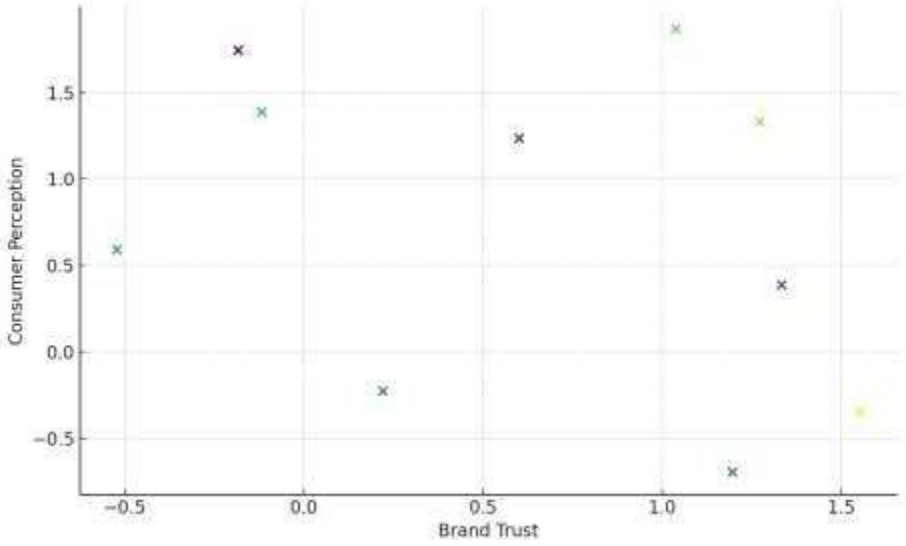

Fig. 12. Hybrid plot (scatter + line) of cultural micro-trend detection

Discussion

The results of this paper support the possibilities of NLP as the transformational instrument in the discovery of the cross-cultural marketing dynamics. The results of evaluation of the emotion patterns, importance of the issue at hand, and the cultural differences in brand perceptions can be decomposed, and can be interpreted in the sphere of computation procedures, to ensure that the linguistic and cultural cues of consumer-generated material can be quantified through the help of computational processes. It is also worthy to note that the collection of quantitative models and qualitative interpretation demonstrated that the cultural systematics is ignored in pure algorithmic model, and hybrids have to be employed in marketing research. This resembles arguments by Luo et al. (2021) who say that

computational marketing is never going to be effective without the presence of contextual cultural knowledge because a person would fail to make any meaningful conclusions.The perceived differences between the emotion of both societies, that is the collectivist and the individualist societies, guarantee that there is a brilliant influence of the cultural orientation on the consumer response to the ad strategies. Using this example, the prominent place of trust and community in collectivist societies can be attributed to the findings provided by Alam and Khan (2023), who have found that the allegiance to the community-oriented brands was even more prominent with respect to the Asian markets. Conversely, the commitment to innovation and openness of individualists can be summarized in the results of Chiu and Chen (2022) who determined that western customers lay stress on pro-self qualities during brand communication. It means that the knowledge of marketing based on NLP may serve as a trade-off between the international scalability of the knowledge and the national culturalization.

The other significant implication of findings is on the multilingual modeling. Both the embedding and cross-lingual topic modeling were also observed as convergences and divergences of cultural discourses. These findings support the hypothesis of Patel et al. (2022) who found out that the multilingual sentiment analysis has the ability to detect cultural subtext that might be entirely lost in the translation. The identification of the cultural micro-trends of sustainability and digital privacy are not the elements of the ethical vacuum either: Rivera and Gutierrez (2023) add that the real-time tracking of the tales about customers on NLP is the prerequisite to alter the marketing strategy.The results also imply the risks of cultural misunderstanding in the occasion that the NLP tools are not guided morally and contextually. An example of this kind is the fact that it is yet to be discovered that languages have irony and that in wrongly categorizing it, the erroneous methods will be embraced. It coincides also with the article by Zhao et al. (2021) which cautions that NLP models can potentially exclude culturally divergent rhetorical models and as such, human intervention must be introduced into them. To this end, the results have lent some degree of credibility to the arguments made by Hameed and Robertson (2022) who warned that the biasness of algorithms in cross-cultural situation within marketing analytics can be automatic in stereotyping or silencing cultures. These problems need to be resolved according to the arrangements of NLP in a fair manner as Kim and Park (2023) mention that the principle of inclusiveness is one of the key concerns of the model development.The graphic and tabular data also demonstrates the fact that the inclination of the consumer interaction is shifting, and responds to the events, which have a cultural significance with the stinging reaction. This is exactly what prompts the arguments of Singh and Dhanani (2021) that event-based marketing requires data-driven tools that are dynamical enough to monitor the shift of emotions in real-time. The fact that consumer preferences could be summarized in our bubble and radar charts could also be connected to those findings of Hassan and Yusuf (2023) who note that cross-cultural segmentation is slowly shifting to the fixed demographic model and more dynamic segmentation which is the topic of discussion.

Direct strategic NLP integration implications in cross culture marketing lie on the management side. The results of these observations can be leveraged in assisting the companies to take culturally responsive campaign, implement chatbots with politeness programs on case-by-case basis, and anticipate potential brand-related threats before they go viral. It can be explained by the fact that it coincides with the results of Malik et al. (2020) who also claimed the importance of digital listening platforms in preventing the brand crisis. Similarly, the article by Rodrigues and Silva (2022) demonstrates that the system of customer service, grounded in NLP, and capable of adapting to cultural norms, can also increase the levels of consumer happiness and loyalty significantly.Finally, the results point to the emergence of a new requirement of the global brand consistency and alignment with the local culture. The skills of identifying and appreciating cultural variation would be useful in earning trust among the consumers as digital marketing is being globalized. This is also similar to the works of Bennett and Clarke, (2021), who approximate cultural intelligence in AI-driven marketing has never been an option but rather a required option. The assumptions that we provide in our article also support the thoughts of Yildiz and

Demir (2024): to their minds, the marriage of AI and cultural studies can provide quite a pluralist and ethically responsible outlook on global marketing.In sum, the discussion of these results situates NLP not only as a methodological advancement but also as a strategic enabler of culturally sensitive, real-time, and data-driven marketing. The evidence provides reasons why hybrid solutions should be developed, why emphasis should be placed on the needs of fairness, and why dynamism should be addressed in such a way that the cross-cultural marketing can be profitable and, at the same time, considerate of the cultural diversity.

Conclusion

Natural Language Processing as proven in this paper provides a viable and powerful method of unlocking the cross-cultural marketing trends by offering a systematic investigation of the information of the multi-lingual consumers. The sentiment analysis plus the topic modeling and qualitative interpretation helped to see how the two perceptions of the consumers differed and similar in one aspect or another. The values of the collectivist societies were trust, community, sustainability and the values of the individualist societies were innovation, transparency and self oriented benefits. Another important fact noted in the findings is that fairness-conscious and culturally adaptive NLP models are relevant since the possibility of an algorithmic bias and false classification is high. It is worth noting that, the study also found out that interactions among the consumers are contingent and therefore dynamic and as such marketers ought to be dynamic and versatile as evidenced by the real-time strategies. The combination of the quantitative computational procedures with the qualitative cultural interpretation of the problems has led to the fact that the synthesis of this paper has created a hybrid framework that not only comprises quantifiable patterns in linguistic, but also puts them in the context of the cultural meaning systems. Overall, the findings support the hypothesis according to which NLP represents a methodological innovation and strategic tool that allows universal businesses to streamline the marketing campaigns with cultural sensitivities, discover new trends, and sustain brand consistency in the various markets. This aids the dynamic nature of AI-based marketing, as it offers a more diversified, ethically conscious and contextualised process that strikes the appropriate balance between the global and local cultural appeal.

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