Visual Narratives and Audience Engagement: Edutainment Interactive Strategies with Computer Vision and Natural Language Processing

Abstract

Purpose

This study explores how the integration of visual storytelling and textual elements within edutainment content drives recursive, emotionally grounded consumer engagement in interactive marketing environments. It challenges linear models of the consumer journey by emphasizing cyclical, meaning-making processes shaped by visual-symbolic and narrative cues.

Design/methodology/approach

Using a multimodal AI-assisted analytical approach, this study draws on natural language processing and computer vision to analyze over 10,000 social media posts from leading educational media brands. It identifies underlying engagement mechanisms by examining how visual themes and textual expressions interact to influence consumer behavior across different stages of the edutainment experience.

Findings

Visual themes, especially those featuring human or natural elements, trigger early-stage attention, while emotionally resonant language anchors deeper involvement. This co-activation supports a recursive engagement model, where consumers continuously reinterpret and contribute to brand narratives through micro-actions and user-generated content. Engagement becomes a dynamic, participatory loop rather than a discrete outcome.

Research implications

Future research could explore how different visual and narrative elements influence emotional and cognitive engagement across diverse consumer groups. Additionally, investigating the long-term impact of recursive engagement on brand loyalty and consumer behavior will be valuable for further advancing interactive marketing theory.

Practice implications

For practitioners in interactive marketing, this research underscores the importance of using visually compelling narratives to craft personalized content that resonates emotionally with consumers. By integrating both emotional and cognitive dimensions into content strategies, brands can enhance consumer engagement. Furthermore, incorporating interactive features, such as user-generated content and real-time feedback loops, is crucial for fostering deeper consumer involvement and strengthening long-term brand loyalty.

Social implications

The growing influence of interactive marketing via edutainment and visual storytelling presents opportunities for brands to create more meaningful content that fosters engagement and learning. By aligning with consumers' values, brands can contribute to societal change, advocating for social and environmental causes while enhancing public awareness and participation.

Originality/value

This research reframes interactive marketing as a psychologically layered and dialogic process, offering new theoretical insight into the symbolic and affective mechanics of edutainment. It provides a data-driven foundation for designing content strategies that foster long-term emotional resonance and participatory brand relationships. By demonstrating how AI tools can decode and optimize multimodal engagement, the study contributes both conceptual advancement and methodological innovation to the field.

Keywords

Interactive marketing, Visual storytelling, Edutainment, Symbolic meaning, Consumer engagement, Natural language processing, Computer vision

1. Introduction

Interactive marketing has undergone a profound transformation, evolving from a traditional, one-way flow of information into a dynamic, interactive dialogue between brands and consumers (Wang, 2025). Historically, marketing was largely a passive process, where brands communicated messages to audiences with minimal feedback or participation. The advent of social media has reshaped this model, giving rise to a more engaging, reciprocal form of communication (Wang, 2023), empowering consumers to interact with brands and to share their opinions, influence content, and co-create marketing narratives (Valenzuela-Gálvez et al., 2022). As a result, consumers have transitioned from passive recipients to active participants, fundamentally altering the way brands engage with their audiences (Tong and Chan, 2023). In an era of fragmented attention spans and selective consumption, it is no longer sufficient for brands to simply deliver information. Instead, they must create experiences that emotionally resonate with their audience (Kim and Kim, 2023). In this newly established paradigm, symbolic visual narratives have emerged as crucial instruments for capturing consumer attention and fostering deeper engagement (Coker et al., 2021). It transforms traditional marketing from mere communication into immersive, shared experiences that drive deeper connections (Wang, 2024). Visual imagery captures attention instantly and evokes emotion, engaging the brain more rapidly and deeply than linear text (Kanuri et al., 2024). This cognitive immediacy forms the foundation for edutainment, which harnesses the persuasive power of visuals to deliver educational content in entertaining, emotionally resonant ways (Khalil et al., 2024). By transforming passive learning into immersive, participatory experiences, edutainment meets the modern consumer’s desire for both engagement and insight, turning marketing into a space where storytelling, learning, and emotional connection converge (Krishen et al., 2024).

Despite the widespread recognition of visual storytelling’s significance in interactive marketing, existing research has predominantly treated visual and textual elements in isolation. Studies have often focused on the impact of either visual or textual strategies independently, without addressing the potent synergy that arises when these elements are used together (Kunz and Wirtz, 2024, Chen et al., 2025). In response, our study proposes an integrated AI-driven methodology combining NLP and computer vision to explore how visual and textual components interact to enhance consumer engagement in marketing content (Hao and Demir, 2024). The central objective of this research is to explore how the combination of visual symbolism and narrative structure influences consumer engagement within edutainment contexts. Specifically, the study seeks to address three key questions: (1) How do visual themes, identified through topic modeling, affect user engagement in an edutainment context? (2) Which textual elements, as analyzed through NLP, most effectively enhance engagement? (3) What are the comparative effects of using visual and textual elements independently versus synergistically, and how do these differences inform interactive marketing strategies?

2. Literature review

2.1 Symbolic Visual Meaning in Consumer Engagement

In the evolving landscape of interactive marketing, symbolic visual meaning is pivotal in shaping consumer engagement, as visual elements have been shown to communicate complex information more efficiently than textual or linguistic representations (Aljukhadar et al., 2020). Narrative paradigm positions storytelling as a central mode of human communication, wherein meaning emerges through narrative logic rather than formal argumentation (Fisher, 1989). When brands are framed as "actors" seeking to achieve the "goals" of consumer needs, visual narratives take on a transactive structure. This configuration invites viewers to decode the intended message while embedding their own interpretations into the narrative arc. The result is a participatory interpretive process that shifts the consumer role from passive viewer to co-narrator, establishing a communicative exchange where meaning is jointly constructed (Shao, 2024). In digital environments, visuals serve as powerful emotional triggers, generating instant responses that are both intense and memorable. Their non-verbal nature allows them to bypass cognitive filters, evoking empathy, identification, and even prompting action. This emotional immediacy captures attention and strengthens recall, making audiences more likely to engage with and respond to the content (Sharakhina et al., 2024). When integrated into interactive narratives, visuals do more than illustrate, they create immersive moments that deepen emotional connection and drive meaningful consumer engagement. Moreover, the Optimal Distinctiveness Theory explains why consumers gravitate toward content that maintains a balance between personal identity expression and social group belonging (Liao et al., 2023). Visuals that satisfy this dual need are more likely to be shared, thereby serving as markers of both individuality and collective affiliation. The compositional arrangement of visual content further shapes how consumers interact with and contribute to brand narratives. Social media platforms facilitate a fluid boundary between content creation and consumption, enabling users to remix, reinterpret, and redistribute branded visuals (Herrada-Lores et al., 2025). This co-creative process reconfigures the locus of authorship. Visuals become vessels for communal storytelling, where meaning is derived from both their aesthetic composition and the contextual interplay with user-generated responses. By leveraging the emotional power of narrative-driven visuals, coupled with interactive participation and co-creation, brands can cultivate deeper, more sustained connections with their audiences (Cuevas et al., 2021).

2.2 Leveraging Edutainment in Interactive Marketing: Cognitive, Emotional, and Co-Creative Dynamics in Consumer Engagement

Collective intelligence, as defined by Lévy (1997) is a dynamic, evolving process that thrives on the differentiation and integration of individual contributions. Within the context of interactive marketing, this collective process fosters a shared identity while enhancing the distinct input of each participant. It is shaped by key elements such as continuous interaction (Aljukhadar et al., 2020), interactive learning (Bertsimas and Mersereau, 2007), distributed collaboration (Achrol and Kotler, 2022), and the expansion of shared knowledge (Varadarajan et al., 2022). Interactive marketing environments serve as platforms where consumers and brands co-create meaning through digital dialogues and engagements, allowing individuals to learn from one another via mediated technologies. Drawing from sociocultural theory, individuals internalize knowledge in these spaces through tools and artifacts that scaffold social learning, echoing Vygotsky's zone of proximal development (Vygotsky and Cole, 1978). This underscores how marketing content, particularly in gamified or edutainment-based formats, can act as a "learning scaffold" that bridges personal and collective understanding. These mediated exchanges promote a shift from intrapsychological processes (internal cognition) to interpsychological interactions (shared cognition), where marketing becomes a cognitive and social act (Valor and Carrero, 2014). Such dynamics are vividly demonstrated in interactive environments, where users alternate between roles of competitors, collaborators, or co-creators. These experiences rely heavily on dialogue, immersion, and engagement, which are foundational to both collective intelligence and the effectiveness of edutainment in marketing (Wang, 2021). By merging education and entertainment, edutainment campaigns stimulate deeper cognitive and emotional involvement, encouraging consumers to actively participate in brand narratives and knowledge exchange (Qin, 2020). At the cognitive level, edutainment enhances consumer attention and comprehension by strategically combining verbal and visual cues. This multimodal presentation strengthens information encoding and retrieval, allowing individuals to absorb and retain content more effectively (Yoo et al., 2023). Visual content plays a critical role in simplifying abstract concepts and enhancing retention, facilitating sustained attention and deeper cognitive processing (Lyu and Huang, 2024). As consumers become mentally engaged, emotional resonance follows through immersive narratives featuring relatable characters and meaningful goals. This affective involvement strengthens perceived relevance, fostering empathic alignment and shaping how brand messages are interpreted and evaluated (Peltier et al., 2024). Within edutainment, emotional and cognitive engagement converge to drive behavioral responses, manifested through participation, customization, and co-creation across interactive platforms, transforming passive viewers into active brand collaborators (Khalil et al., 2024).

2.3 AI in Social Media Engagement Analysis

AI transforms interactive marketing by offering data-driven approach to understanding and engaging consumers. By analyzing key engagement metrics such as likes, shares, comments, and click-through rates, AI can predict future interactions and tailor content to suit individual user preferences (Peltier et al., 2024). Supervised learning algorithms use historical data to refine content delivery, while unsupervised methods, like clustering and association rule mining, uncover hidden user patterns, improving content targeting and audience segmentation (Hao and Demir, 2024). NLP enhances this by processing large volumes of text data from social media, performing sentiment analysis to gauge the emotional tone of discussions, and topic modeling to identify trending themes (Graham and Stough, 2025). This enables brands to craft educational content that resonates emotionally and aligns with cognitive needs, strengthening engagement. Moreover, computer vision enables the analysis of visual elements, such as color, shapes, facial expressions, and image content, linking these features to engagement metrics like time spent on content, interactions per post, and conversion rates (Kang and Lou, 2022). By integrating visual and textual data, brands gain a holistic view of consumer interaction across platforms. This comprehensive understanding allows marketers to create immersive edutainment experiences that foster both intellectual and emotional involvement, driving sustained attention and participation (Johnson et al., 2023). Through AI-powered insights and creative storytelling, brands can craft dynamic content strategies that encourage active consumer participation and deepen emotional connections with the audience.

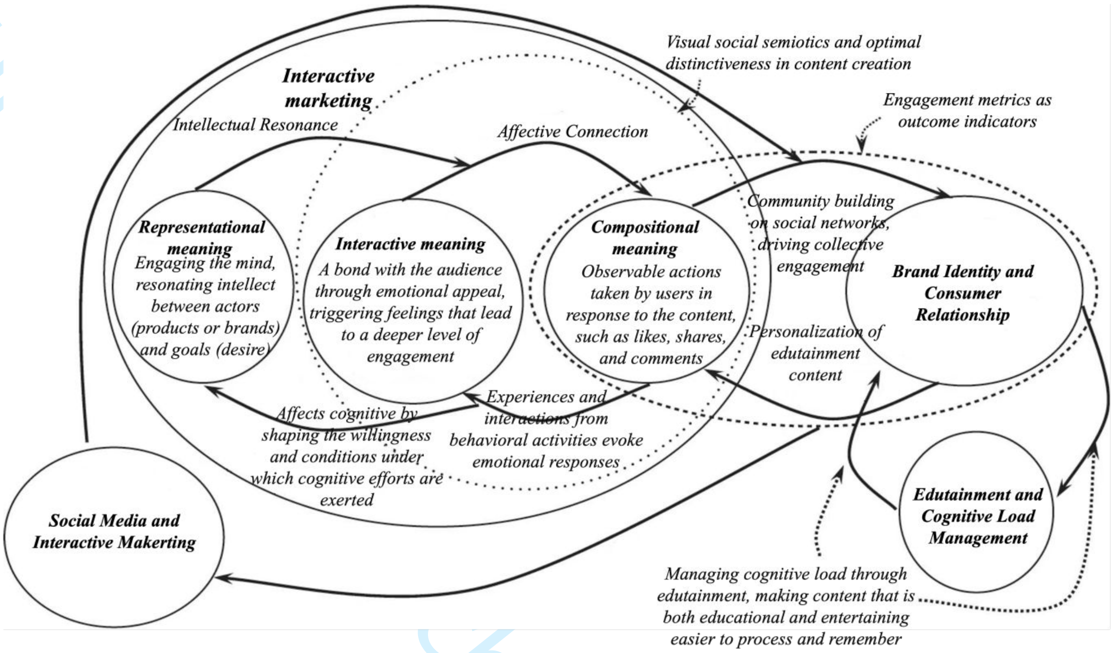

Figure 1. Conceptual map.

Figure 1 illustrates a cyclical and integrative framework for understanding consumer engagement within the context of social media-based interactive marketing. It delineates how various layers of meaning, representational, interactive, and compositional, interact to produce cognitive and emotional resonance, ultimately shaping brand identity and consumer relationships. The process begins with representational meaning, where consumers engage cognitively by interpreting visual narratives that align a brand (as the actor) with consumer goals or desires. This symbolic alignment initiates intellectual resonance, serving as a cognitive entry point for deeper engagement.

As consumers progress through the engagement process, interactive meaning emerges through emotional responses elicited by experiences, behaviors, and symbolic storytelling. Emotional resonance deepens involvement by establishing affective bonds between the consumer and brand, setting the stage for more sustained interaction. This transition from cognitive to emotional processing reflects the dual-channel pathways through which meaning is constructed and internalized in interactive marketing environments. Compositional meaning operationalizes these responses by capturing observable actions, such as likes, shares, and comments, that indicate how users interact with and respond to content. These behavioral cues are not merely passive reactions; they signal active participation in content circulation and community co-creation. At this stage, content personalization becomes crucial, particularly in edutainment contexts, where educational material is adapted to be both cognitively manageable and emotionally engaging. This is where cognitive load management intersects with symbolic communication, optimizing content so it is easier to process, remember, and act upon. The framework is supported by AI-enabled engagement analytics, which act as feedback mechanisms to assess emotional and cognitive impact. Ultimately, the integration of representational, emotional, and behavioral dynamics converges in the development of brand identity and consumer relationships, reinforced through community building and iterative personalization. This conceptual map captures the recursive nature of engagement: cognitive attention leads to emotional involvement, which is expressed through behavioral interaction, fed back through AI analysis, and translated into adaptive content strategies.

3. Methodology

The research process (Figure 2) begins with Data Extraction, where raw data is collected via Instagram Application Programming Interfaces (APIs), following the protocols outlined by Grewal et al. (2021), the process begins with assembling a Source Dataset to structure the extracted data. This is followed by Data Preprocessing and Feature Engineering, where the data is cleaned and relevant features are prepared for model input. The Microsoft Azure AI Vision Service is then used to extract visual features, followed by model training and evaluation. Concurrently, Topic Modeling is applied to uncover hidden themes in the text, with the number of topics optimized using Coherence Scores. After identifying the optimal number of topics, the Topic Model is refined, and its significance is analyzed. Finally, the Optimized Engagement Prediction Model is evaluated to predict user engagement, with the insights applied to assess engagement for the identified topics.

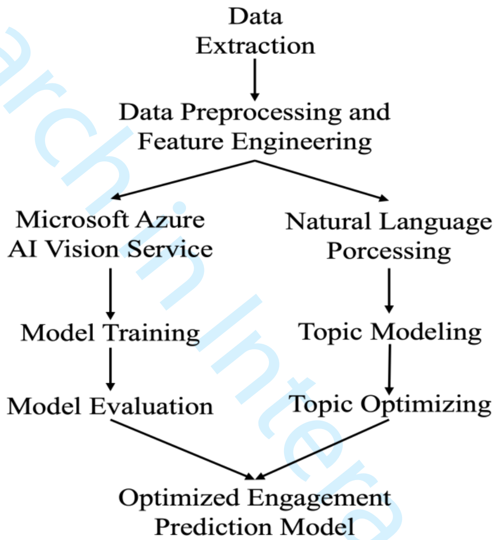

Figure 2. Process Flow.

3.1 Data extraction and dataset preparation

In December 2023, a comprehensive dataset was assembled using the Instaloader (instaloader.github.io), a Python-based tool designed for data extraction on Instagram. The dataset incorporated various metrics indicative of user engagement, including URLs of individual posts, counts of comments and likes, captions, image URLs, and the presence of video content. According to Table 1, National Geographic stands out with an impressive follower count of 283 million, dwarfing PBS Nature's modest 150,000 followers. Notably, both BBC Earth and National Geographic exhibit considerable online activity, each with a post count exceeding 3,000, which markedly surpasses the post frequency of the other entities in the dataset, all of which have posted in excess of 1,000 times.

Table 1. Social Media Engagement Data (Acquired on 15th December 2023).

Brand	User Name	Total Posts	Number of followers
National Geographic	natgeo	3,161	283M

BBC Earth	bbearth	3,662	10.5M
Animal Planet	animalplanet	1,127	5.5M
PBS Nature	pbsnature	1,000	150K
The Discovery	discovery	1,548	19.5M

3.2 Data preprocessing and feature engineering

The data preprocessing methodology in this research follows a sequential approach (Onikoyi et al., 2023). Text is first converted to lowercase to unify word variations, then non-ASCII characters are removed. Lemmatization is applied to reduce words to their dictionary form, and punctuation is stripped to minimize noise. Finally, Term-Frequency - Inverse Document Frequency (TF-IDF) vectorization is used for English words, reflecting the importance of a word in a document relative to its frequency across all documents (Berger et al., 2020).

The engagement metric is the target variable for feature engineering (Kamal and Bablu, 2022). Features like 'number_of_likes' and 'number_of_comments' are standardized by dividing them by their maximum values (Rajendran and Karthi, 2022). The post with the highest values for each feature will have them scaled to one. The engagement score is calculated as a weighted average of the standardized likes and comments. The median number of comments (237) and likes (51,000) are used to classify posts as high or low engagement, with posts exceeding the median categorized as high engagement (Narayanan, 2023).

Model evaluation is crucial for assessing predictive models (Shmueli et al., 2019), providing a quantitative measure of performance and identifying areas for improvement. Without thorough evaluation, the model's predictions lack reliability in real-world applications (Sharma and Shafiq, 2022). We used Accuracy, ROC-AUC, and F1-Score to evaluate our models. Accuracy provides a direct measure of effectiveness (Dhaoui et al., 2017), while ROC-AUC assesses the model's ability to distinguish between classes, with a score close to 1 indicating strong performance (Berger, 2013). The F1-Score balances precision and recall, crucial when false positives and false negatives have different costs, such as misidentifying high or low engagement posts (Chicco and Jurman, 2020).

3.3 Computer vision

Prior to incorporating all images, it is necessary to extract visual features from the images obtained via their respective URLs (Philp et al., 2022). For each image, descriptive labels were generated by employing the Object Identification module within Microsoft Azure's Computer Vision Services (Lee et al., 2022). This service enables the application of Microsoft's advanced pre-trained models to discern and classify visual information within the images. Typically, an array of tags or labels is associated with each image, providing a multi-faceted representation of its content. The classification models were trained to predict whether a post will receive high engagement or not. The median of each brand was used to calculate the binary target to account for the differences in the number of followers. It is framed as a binary classification problem (Zhu et al., 2021). Since the target variable was split using the median, the classes are well-balanced for the classification model. A total of six different datasets categorized as Global Models and Individual models were used to train the classification models. All the models we validated using 20% of the data that was held out during the training for evaluation of unseen data. The data was split randomly into train and test using the train_test_split function from the sklearn package.

i) Global model: Contains all posts of all the different brands.

ii) Five different individual models with each dataset containing only the data of a single brand.

For both sets of datasets, models were trained using features generated by the corresponding captions and labels split into three feature groups.

iii) Only Text Model - Captions only features

ii) Only Image Model - Labels only feature

iv) Both Text and Image - Captions + Label Features

3.4 Natural language processing

Topic modeling, particularly LDA, is a key tool in text mining and NLP, widely used in marketing (Das et al., 2023). LDA was chosen for its ability to handle large datasets and uncover latent structures, which is crucial in marketing research (Pavlinek and Podgorelec, 2017). The process began with data review and pre-processing, including tokenization, stop-word removal, and lemmatization, to optimize the corpus for topic modeling (Albalawi et al., 2020). Coherence measures helped determine the optimal number of topics by evaluating semantic similarity, with higher scores indicating more meaningful topics (Abdelrazek et al., 2023).

3.5 Optimized engagement prediction model

Logistic regression estimates the probability of an event, such as a social media post receiving high engagement, based on independent factors (Li and Xie, 2020). Unlike linear regression, it is suited for binary outcomes like 'high' or 'low' engagement (Table 2). To handle the complexity of numerous text features, L1 regularization (Lasso) was applied to eliminate irrelevant coefficients, simplifying the model without losing predictive power (Yang et al., 2023).

Table 2. Engagement Classification Based on Median Scores for Different Brands.

Brand	High Engagement	Low Engagement	Total Posts
National Geographic	1,580	1,581	3,161
BBC Earth	1,831	1,831	3,662
Animal Planet	564	563	1,127
PBS Nature	500	500	1,000
The Discovery	774	774	1,548
All Brands Together	5,249	5,249	10,498

4. Results

4.1 Model Performance

The area under the ROC-AUC curve is 0.63, which suggests that the model has a moderate ability to distinguish between the two classes (Figure 3). The red dot at a threshold of 0.50 indicates a specific point on the ROC curve where the true positive rate and false positive rate are both just above 0.5, implying that this threshold provides a balance between sensitivity and specificity for the classifier in question.

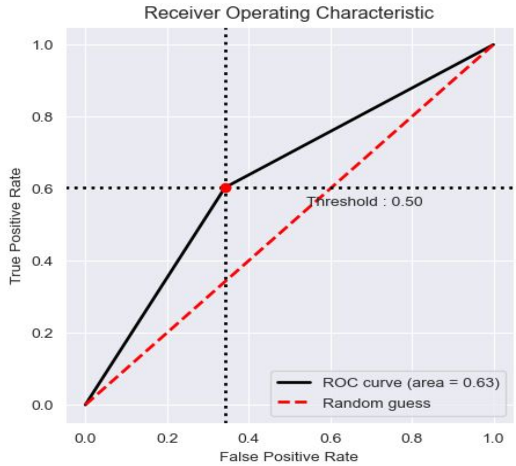

Figure 3. Receiver Operating Characteristic Curve.

The confusion matrix (Figure 4) shows that the model is quite adept at identifying class 0, with a commendable number of 713 instances accurately classified as true negatives. It also demonstrates a substantial ability to recognize class 1, with a total of 613 true positives. The model does encounter some challenges, such as misclassifying 371 instances of class 0 as class 1 (false positives) and 403 instances of class 1 as class 0 (false negatives).

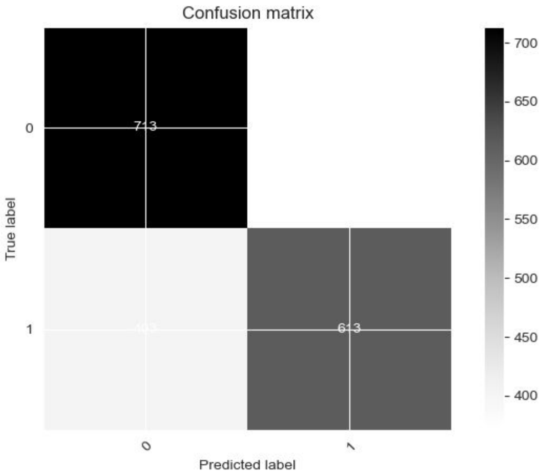

Figure 4. Confusion Matrix.

4.2 Feature Importance

Figure 5 presents a bar chart detailing the influence of various textual features on the predictive performance of a social media engagement model. The chart reveals ‘amazinganimal’, ‘video’, and ‘landmammal’ as the most positively influential features, with ‘amazinganimal’ exhibiting the highest importance score, suggesting a substantial positive correlation with increased user engagement. On the opposite spectrum, features such as ‘community’, ‘watch’, and ‘bbcearth’ demonstrate the most significant negative impact, with ‘bbcearth’ showing the largest negative score, indicating a strong inverse correlation with engagement.

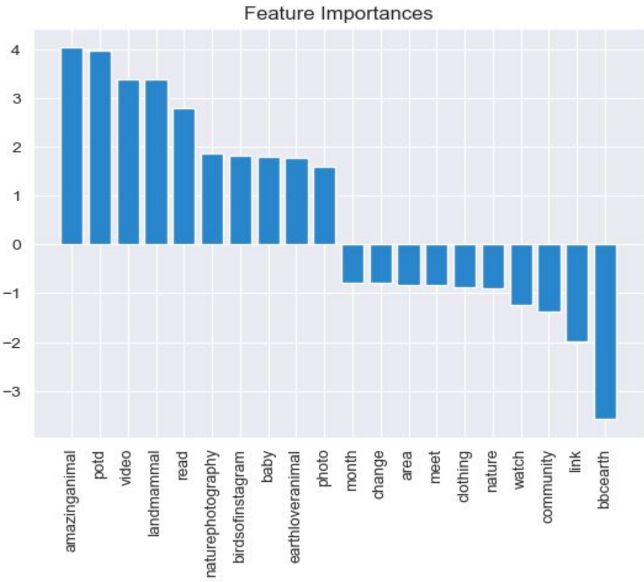

Figure 5. Feature Importance Plot.

4.3 Comparison of Predictive Models

Table 3 evaluates three predictive models for social media engagement using captions, labels, or a combination of both. The "Captions Only" model outperformed others (66% accuracy, 0.71 ROC-AUC), with high-engagement terms such as *earthlover*, *potd*, and *landmammal*, while *community* and *bbcearth* were negatively associated. The "Labels Only" model showed lower predictive power (59% accuracy, 0.62 AUC), though visually salient terms like *leopard* and *wing* contributed positively. The combined model achieved balanced performance (63% accuracy, 0.68 AUC), reinforcing the impact of caption-driven features. Among the 18 evaluated models, the global model was the most robust, offering broad applicability across brands by using median engagement scores to adjust for follower differences. The captions-only model achieved 65% accuracy, 0.71 ROC-AUC, and 0.64 F1-score, with terms like 'earthlover' and 'potd' boosting engagement, while terms like 'bbcearth' and 'community' correlated with lower interaction. The model combining captions and labels showed slightly lower performance (63% accuracy, 0.68 ROC-AUC, 0.61 F1-score), with 'amazinganimal' and 'video' increasing engagement, while 'link' and 'watch' decreased it. Appendix 1 shows that 'amazinganimal' was linked to higher engagement in 71% of top posts, with a coefficient of 4.06. Appendix 2 highlights that terms like 'link' and 'watch' are associated with reduced engagement, suggesting a need for revised content strategies.

Table 3. Accuracy, ROC AUC Score, F1 Scores, and words contribute to positive and negative engagement of predictive models with different feature sets.

Feature Set	Accuracy	ROC_AUC	F1	Confusion Matrix	Top 10 Positive Words	Top 10 Negative Words
Captions Only	0.66	0.71	0.64	[[748, 336], [384, 632]]	earthlover, potd, landmammal, read, ornithology, video, vid,	story, earthcapture, team, bio, community, episode, bbc,

Labels Only	0.59	0.62	0.61	[[582, 454], [405, 659]]	amazinganimal, beautifulbird, baby leopard, new, wing, star, rodent, human, animal, snake, penguin, whale	earthonlocation, pm, bbcearth landform, wearing, man, aqua, breed, transport, body, sun, clothing, chimpanzee
Captions and Labels Together	0.63	0.68	0.61	[[713, 371], [403, 613]]	amazinganimal, potd, video, landmammal, read, naturephotography , birdsofinstagram, baby, earthloveranimal, photo	month, change, area, meet, clothing, nature, watch, community, link, bbcearth

4.4 Topic Modeling and Thematic Engagement

According to Figure 6, both 5 and 7 topics produce higher coherence scores than 3, 4, and 6 topics, suggesting that these configurations offer the most semantically consistent and coherent interpretation of the corpus. The dip in coherence at 6 topics indicates that the corpus does not naturally separate into six distinct topics, making 5 or 7 topics more suitable for analysis.

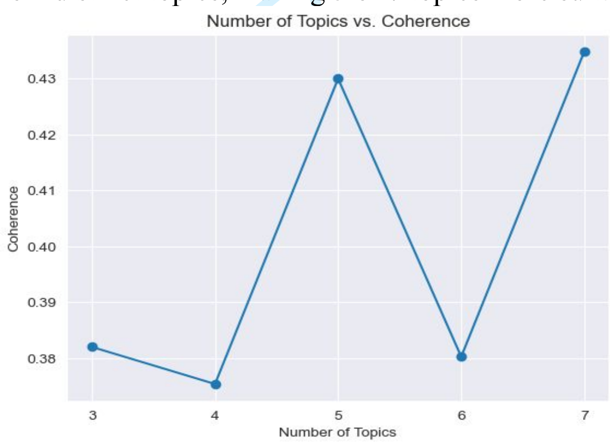

Figure 6. Number of topics vs Coherence.

The pyLDAvis tool visualizes these findings, with Figure 7 showing an Intertopic Distance Map and the Top-30 Most Salient Terms for one of the five topics. The map highlights the relative positioning of the topics, where proximity between bubbles indicates similarity. Topics 1 and 3 show some overlap, suggesting a thematic correlation, while Topics 2, 4, and 5 are more distinct, reflecting unique thematic content. The size of the bubbles indicates the relative prevalence of each topic in the corpus, with larger bubbles representing more dominant topics. On the right, the bar chart displays the most relevant terms for Topic 1, such as “bird”, “marine”, and “wildlife” ,which reveal the naturalistic focus of this topic.

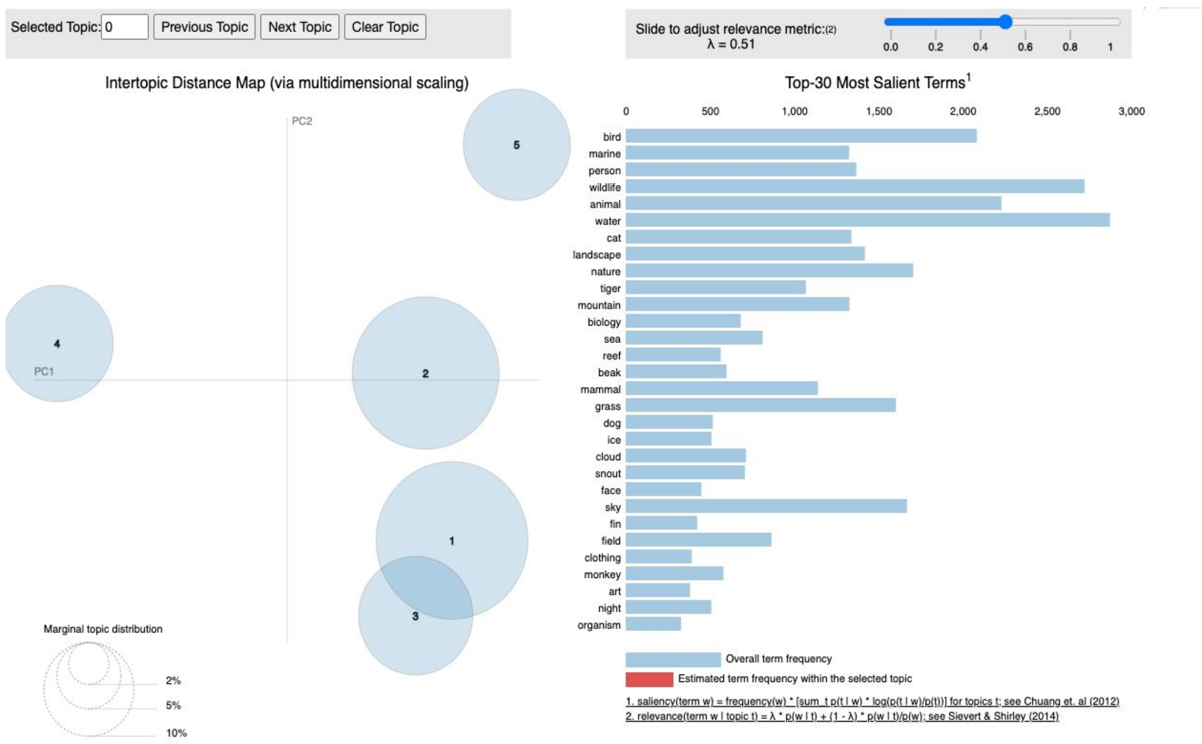

Figure 7. pyLDAvis tool and the visualization of topics.

In Figure 8, the Intertopic Distance Map further emphasizes the isolation or overlap between topics, complementing the previous figure by focusing on a different topic. Again, bubble size reflects the discourse share of each topic, while the bar chart illustrates the Top-30 Most Relevant Terms for another topic, showing a focus on terms like “animal,” “wildlife,” and “outdoor,” suggesting that this topic is heavily associated with naturalistic themes. Terms like “tortoise” and “field,” while less frequent, are also significant, providing additional context within the broader thematic landscape.

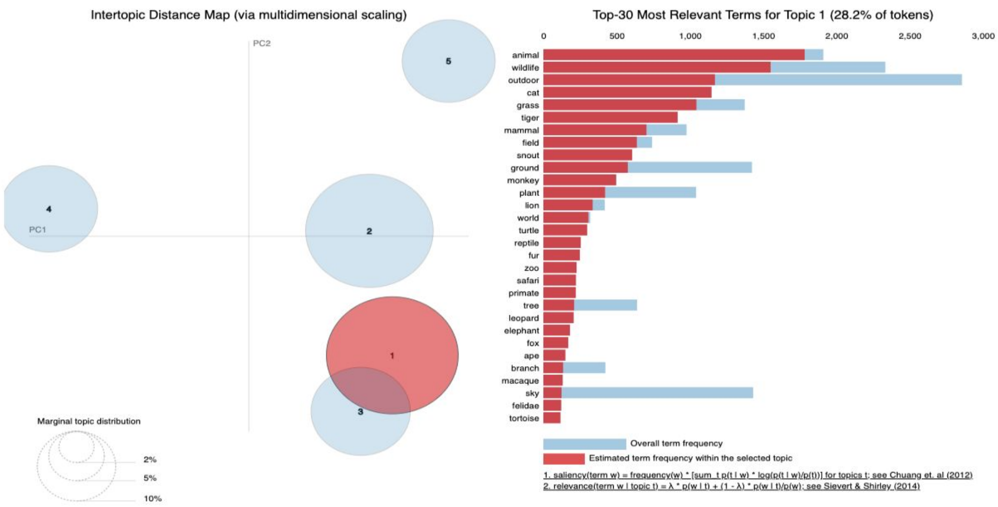

Figure 8. Topic Dominance and Keyword Specificity in Content Analysis.

Tables 4 and 5 provide further insight into the topic modeling results, summarizing the terms that define each topic. For example, Topic 1, "Wildlife Kingdom," is characterized by terms like "animal," "wildlife," and "tiger," reflecting its focus on ecological and biological themes. Topic 2, "Natural Wonders," emphasizes outdoor scenery and environmental photography, with terms like "nature," "landscape," and "mountain." "Avian Serenity" (Topic 3) merges avian life with celestial themes, while "Human Portraits" (Topic 4) centers on personal and social aspects of human life, as indicated by terms like "person," "dog," and "clothing." Finally, "Marine Exploration" (Topic 5) is dominated by terms related to marine ecosystems, such as "marine," "reef," and "shark."

Table 4. Topical Word Frequencies Across Five Distinct Topics.

Topics	**Word 1**	**Word 2**	**Word 3**	**Word 4**	**Word 5**	**Word 6**	**Word 7**	**Word 8**	**Word 9**	**Word 10**
Topic 1	animal	wildlife	cat	tiger	grass	outdoor	snout	field	mammal	monkey
Topic 2	nature	landscape	mountain	sky	water	cloud	plant	sunrise	outdoor	photography
Topic 3	bird	beak	wildlife	night	space	star	branch	penguin	moon	seal
Topic 4	person	dog	ice	face	clothing	art	indoor	cap	man	woman
Topic 5	marine	biology	water	reef	sea	fin	organism	shark	aquarium	underwater

Table 5. Topic Identification.

Topic	**Theme**
Topic 1	Wildlife Kingdom
Topic 2	Natural Wonders
Topic 3	Avian Serenity

Topic 4	Human Portraits
Topic 5	Marine Exploration

Table 6 links these topics to user engagement, revealing that "Human Portraits" commands the highest proportion of high engagement posts at 54.40%, followed closely by "Wildlife Kingdom" at 53.77%. "Marine Exploration" shows moderate engagement at 47.94%, while "Avian Serenity" and "Natural Wonders" exhibit lower engagement at 45.29% and 45.03%, respectively.

Table 6. Proportion of High Engagement Posts.

Topic	Proportion of High Engagement Posts
Human_Portraits	54.40%
Wildlife_Kingdom	53.77%
Marine_Exploration	47.94%
Avian_Serenity	45.29%
Natural_Wonders	45.03%

5. Discussion

Today's audiences, especially within social media environments, are no longer passive recipients of content, they demand experiences that are emotionally resonant, cognitively enriching, and personally relevant. Edutainment, content designed to educate through entertainment, meets this demand by blending informational value with affective appeal, transforming learning into an accessible and desirable experience (Khalil et al., 2024). Visual storytelling intensifies this impact, using the immediacy of imagery to convey complex ideas with clarity and emotional depth, allowing consumers to connect with content both intuitively and reflectively (Ryu, 2024). As digital ecosystems grow increasingly visual and interactive, understanding how narratives are constructed through the interplay of image and language becomes essential for brands seeking to foster sustained, reciprocal relationships (Swaminathan et al., 2022). Against this backdrop, traditional conceptions of the consumer journey, often framed as linear progressions from awareness to purchase, prove inadequate. In edutainment-driven interactive marketing, the consumer journey is better understood as a recursive, psychologically layered cycle in which each encounter with content is shaped by prior experiences and anticipates future engagements (Ahmed et al., 2024). Emotional and cognitive responses do not simply follow sequential stages; they accumulate, interact, and feed back into the journey, forming a dynamic loop of participation and meaning making (Kim, 2024). Studying this evolving form of engagement offers timely insights into how consumers make sense of content, construct identities, and forge connections in the saturated, visually driven environments that now define digital life.

In the initial stages of consumer engagement, visual narratives function as the primary entry point into meaningful interaction (Malodia et al., 2024). The data from this study indicate that imagery featuring human faces, natural landscapes, or wildlife, particularly those that evoke emotional familiarity, serves as a powerful stimulus for attention. These visual cues draw on inherent psychological mechanisms such as pareidolia and narrative inference, creating an immediate affective response that extends the duration of attention and invites reflective processing (Shen et al., 2024). When complemented by semantically resonant textual cues, the visual content signals a level of personal alignment, suggesting that the consumer's values, interests, or aspirations are being acknowledged (Al-Tameemi et al., 2024). This perception of mutual recognition often initiates micro-engagement behaviors such as liking, commenting, or sharing. Rather than incidental reactions, these behaviors represent meaningful gestures that reflect the user's emotional and cognitive involvement. In this way, consumers begin to integrate the brand's message into their personal interpretive frameworks, allowing the content to take root within their everyday digital experiences.

As the consumer progresses into a more evaluative mindset, the narrative function of content begins to shift. At this stage, the experience must support discernment while maintaining affective connection. Content that feels too generic or excessively promotional tends to be bypassed in favor of material that feels sincere and contextually relevant. A well-calibrated balance of emotional texture and informational clarity provides consumers with both the motivation to stay engaged and the tools to make thoughtful decisions (Drossos et al., 2024). In edutainment-driven contexts, this balance is achieved through visuals that are emotionally compelling and language that is conceptually transparent. Effective content at this phase presents complex ideas with clarity, inviting consumers to engage intellectually without overwhelming them. When consumers encounter media that validates their sense of self while supporting decision-making, trust is reinforced (Kim et al., 2025).

Following the point of purchase, visual narratives continue to shape the consumer's experience, though the objective now moves toward affirmation and continuity. Post-purchase content functions as a mirror, reflecting back the values associated with the consumer's decision. Imagery and language that emphasize shared ideals, community, purpose, environmental awareness, personal growth, anchor the consumer's actions within a broader narrative arc. Through this reflective process, consumers are encouraged to revisit and reinterpret their relationship with the brand, not as a static memory, but as an evolving part of their self-concept (He and Zhang, 2022). Importantly, this stage also introduces opportunities for consumer expression. Storytelling becomes dialogic, consumers begin contributing their perspectives through reviews, comments, and personal stories (Crespo et al., 2023). These participatory actions grant consumers a degree of narrative authorship, reinforcing their emotional ties and embedding the brand further into their cultural and personal lives.

What emerges from this cycle is a model of engagement that is fluid, recursive, and dialogically constructed. Consumer involvement unfolds not through isolated reactions but through a sequence of recognitions, reflections, and reinforcements that evolve across time. Emotional and cognitive dimensions of engagement operate in parallel and in tandem, responding to the shape and texture of content at each touchpoint (Ahmed et al., 2024). Visual storytelling that evokes emotional identification while guiding conceptual understanding activates both processes simultaneously, generating a deeper and more durable connection. Within the context of edutainment, this dual engagement becomes particularly salient, as audiences navigate content that seeks to inform without compromising on enjoyment (Chong et al., 2024). The findings suggest that the success of interactive marketing in this space relies less on the novelty of technological delivery and more on the psychological precision of narrative construction, how effectively content anticipates emotional cues, speaks to internal motivations, and accommodates critical thought (Hao et al., 2024). In this mechanism, engagement ceases to be a momentary metric of attention and becomes a measure of relational resonance, accumulated, sustained, and continually shaped through collaborative meaning-making.

6. Conclusion

This study provides a novel perspective on how visual storytelling and textual cues jointly shape user engagement within the interactive marketing landscape of edutainment. Rather than treating consumer engagement as a one-directional progression from awareness to purchase, our findings suggest that engagement unfolds as a recursive and emotionally layered process, where each content encounter is shaped by prior experiences and in turn redefines future interactions. In this dynamic process, visual and textual content elements act not merely as tools for message delivery but as interwoven narrative mechanisms that influence how consumers feel, think, and participate in brand experiences.

Visual storytelling plays a foundational role in capturing attention and initiating affective responses at the early stages of the consumer journey. In interactive marketing contexts, especially those driven by edutainment, this visual component acts as a powerful stimulus for engagement by tapping into consumers' social cognition and emotional memory. Familiar patterns, such as human faces, natural scenes, or symbolic imagery, evoke recognition and emotional proximity, encouraging users to move beyond passive viewing and toward immersive interaction. When these visual cues are strategically paired with emotionally aligned textual expressions, language that reinforces the narrative tone, intention, or cultural relevance, the synergy between modalities amplifies cognitive and emotional processing. This co-activation leads to more meaningful engagement behaviors, such as liking, commenting, or sharing, which function as micro-signals of the consumer's interpretive alignment and affective investment. These micro-interactions, though often subtle, represent an important layer of participatory meaning-making. Rather than viewing them as isolated actions, they can be understood as early indicators of narrative transportation and personal identification with brand stories. As the consumer journey progresses into more evaluative stages, visual and textual cues continue to operate as dual channels guiding decision-making. At this point, consumers are not simply seeking entertainment or information, they are searching for content that aligns with their self-concept, social values, and aspirational goals. Effective edutainment content sustains this engagement by providing emotional resonance and conceptual clarity simultaneously. It supports consumers as they negotiate the symbolic value of what they consume, linking brand messaging to broader identity narratives and lived experiences. Crucially, this emotional-cognitive integration transforms content from a persuasive device into a vehicle for self-exploration and psychological meaning. Content that resonates across both channels becomes transformative, it empowers the consumer to feel seen, understood, and connected. In this way, the brand becomes less of a message sender and more of a narrative partner in the consumer's unfolding sense of self. Post-engagement, the interaction does not end but enters a new phase of narrative re-entry. Consumers revisit the brand from a different vantage point, one shaped by prior emotional experience and social recognition. Content in this stage shifts from driving action to affirming identity, reinforcing shared values and deepening relational ties. Visual storytelling operates as a mirror, reflecting community, ideals, and symbolic alignment, while textual content invites user contribution, whether through comments, reinterpretations, or content co-creation.

This study contributes to the understanding of consumer engagement within interactive marketing, particularly in the context of edutainment. By integrating visual storytelling and participatory engagement, it opens new avenues for research on how emotional and cognitive engagement interact to shape consumer behavior. Future studies can explore the psychological mechanisms behind visual storytelling in more detail, investigating how different types of visuals and narrative structures impact emotional and cognitive responses across various demographic groups. Additionally, this research encourages further exploration into the long-term effects of recursive engagement, examining how repeated brand interactions influence consumer loyalty and brand affinity over time. For practitioners, this study offers valuable insights into how visual narratives can be used to craft personalized and emotionally resonant content that fosters deeper consumer engagement. Brands should focus on creating content that aligns with consumers' values and aspirations, enhancing the emotional connection and trust. The study also highlights the importance of integrating both emotional and cognitive dimensions in content design, ensuring that edutainment content is entertaining informative and intellectually stimulating. Furthermore, interactive features such as user-generated content and real-time feedback loops should be incorporated into marketing strategies to encourage consumers to become co-creators of the brand narrative, ultimately strengthening brand loyalty and long-term engagement. From a societal perspective, the rise of edutainment and visual storytelling presents an opportunity for more meaningful and impactful content consumption. By merging education with entertainment, brands can contribute to a more informed and engaged public, fostering a culture of learning through enjoyable experiences. As consumers increasingly seek content that aligns with their personal values, there is an opportunity for brands to use their platform to advocate for social causes, environmental awareness, and positive societal change.

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No potential conflict of interest was reported by the author(s).

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Appendix 1. Positive engagement words from the label and captions model.

word	co_efficient	brand	post_url	num_comments	num_likes	median_num_likes	median_num_comments	prop_high	prop_likes_above_median	prop_comments_above_median
amazinganimal	4.057836634	bbcearth	https://www.instagram.com/p/CMPaQ4eIzTK/	3118	355501	48025	205	0.711	0.726	0.629
amazinganimal	4.057836634	pbsnature	https://www.instagram.com/p/B7b66_Hl87y/	9	1712	741	9	0.711	0.726	0.629
amazinganimal	4.057836634	animalplanet	https://www.instagram.com/p/Cq6KyxzNpwS/	75	13312	17762	98	0.711	0.726	0.629
potd	3.985380632	natgeo	https://www.instagram.com/p/CqdLOaRs6tC/	40332	532241	119748	616	0.593	0.616	0.632
potd	3.985380632	discovery	https://www.instagram.com/p/CZmm1OavlZM/	2087	288352	35910.5	158	0.593	0.616	0.632
potd	3.985380632	animalplanet	https://www.instagram.com/p/CVN2B8-pEP3/	2122	374472	17762	98	0.593	0.616	0.632
video	3.400453573	discovery	https://www.instagram.com/p/ChAkHMeANwz/	6105	1960724	35910.5	158	0.596	0.582	0.628
video	3.400453573	natgeo	https://www.instagram.com/p/CqdLOaRs6tC/	40332	532241	119748	616	0.596	0.582	0.628
video	3.400453573	pbsnature	https://www.instagram.com/p/CvPvCtsJd6f/	43	4091	741	9	0.596	0.582	0.628
video	3.400453573	animalplanet	https://www.instagram.com/p/CebsCgjAoji/	2156	200816	17762	98	0.596	0.582	0.628
video	3.400453573	bbcearth	https://www.instagram.com/p/CK1phYMjLbk/	1682	163926	48025	205	0.596	0.582	0.628
landmammal	3.384863831	bbcearth	https://www.instagram.com/p/COfib9HHTuJ/	4122	369519	48025	205	0.696	0.697	0.66
landmammal	3.384863831	natgeo	https://www.instagram.com/p/CfZv2IYgWSQ/	5697	1498784	119748	616	0.696	0.697	0.66
read	2.800573829	natgeo	https://www.instagram.com/p/CqdLOaRs6tC/	40332	532241	119748	616	0.425	0.4	0.501
read	2.800573829	bbcearth	https://www.instagram.com/p/CN9faq2Glte/	757	147567	48025	205	0.425	0.4	0.501

read	2.800573829	discovery	https://www.instagram.com/p/CRjZ6nanU7p/	383	34921	35910.5	158	0.425	0.4	0.501
naturephotography	1.865675343	bbcearth	https://www.instagram.com/p/CZPinHCofbN/	3551	369355	48025	205	0.651	0.664	0.594
naturephotography	1.865675343	pbsnature	https://www.instagram.com/p/B-PyWUmnHV_/	38	2023	741	9	0.651	0.664	0.594
naturephotography	1.865675343	discovery	https://www.instagram.com/p/COqfjBohECu/	561	143976	35910.5	158	0.651	0.664	0.594
naturephotography	1.865675343	natgeo	https://www.instagram.com/p/CiVyufcrtpk/	729	235389	119748	616	0.651	0.664	0.594
naturephotography	1.865675343	animalplanet	https://www.instagram.com/p/CZdODOvtz6F/	66	16275	17762	98	0.651	0.664	0.594

Appendix 2. Negative engagement words from the label and captions model.

word	co_efficient	brand	post_url	num_comments	num_likes	median_num_likes	median_num_comments	prop_high	prop_likes_above_median	prop_comments_above_median	is_video
link	-1.997684536	natgeo	https://www.instagram.com/p/Ci2_4YsuWb-/	46255	157545	119748	616	0.401	0.378	0.447	FALSE
link	-1.997684536	pbsnature	https://www.instagram.com/p/B7Y1Z3Zngm1/	103	3854	741	9	0.401	0.378	0.447	TRUE
link	-1.997684536	bbcearth	https://www.instagram.com/p/CVlHXLHL3GR/	2486	200361	48025	205	0.401	0.378	0.447	TRUE
link	-1.997684536	discovery	https://www.instagram.com/p/ClZYV-vPbq2/	688	231511	35910.5	158	0.401	0.378	0.447	TRUE
link	-1.997684536	animalplanet	https://www.instagram.com/p/CZKJmxPNpAU/	280	21877	17762	98	0.401	0.378	0.447	TRUE
community	-1.363756088	natgeo	https://www.instagram.com/p/CqdLOaRs6tC/	40332	532241	119748	616	0.448	0.443	0.502	FALSE
community	-1.363756088	pbsnature	https://www.instagram.com/p/ClCqJvergz0/	36	3875	741	9	0.448	0.443	0.502	TRUE
community	-1.363756088	bbcearth	https://www.instagram.com/p/CmHgc2Xtg5a/	839	72452	48025	205	0.448	0.443	0.502	TRUE
community	-1.363756088	discovery	https://www.instagram.com/p/CelJScvhNWX/	451	23925	35910.5	158	0.448	0.443	0.502	TRUE
community	-1.363756088	animalplanet	https://www.instagram.com/p/CSeoWHBt--V/	93	18449	17762	98	0.448	0.443	0.502	FALSE
watch	-1.237883073	bbcearth	https://www.instagram.com/p/CKhIETxnjiG/	2975	527227	48025	205	0.427	0.423	0.451	TRUE
watch	-1.237883073	pbsnature	https://www.instagram.com/p/B22S3LjnZ20/	102	3710	741	9	0.427	0.423	0.451	TRUE
watch	-1.237883073	discovery	https://www.instagram.com/p/CQvtFjwgo3r/	3268	181369	35910.5	158	0.427	0.423	0.451	TRUE

watch	-1.237883073	natgeo	https://www.instagram.com/p/Ct1yKgHAHXB/	23655	172279	119748	616	0.427	0.423	0.451	TRUE
watch	-1.237883073	animalplanet	https://www.instagram.com/p/CdTIUDCl1Do/	376	138146	17762	98	0.427	0.423	0.451	TRUE
nature	-0.891147589	pbsnature	https://www.instagram.com/p/CXZKWY0MWq0/	89	12900	741	9	0.449	0.449	0.445	TRUE
nature	-0.891147589	bbcearth	https://www.instagram.com/p/Cqc3q82O_Ws/	1931	616109	48025	205	0.449	0.449	0.445	TRUE
nature	-0.891147589	discovery	https://www.instagram.com/p/Ci_eRoVgPmc/	2420	189330	35910.5	158	0.449	0.449	0.445	TRUE
nature	-0.891147589	natgeo	https://www.instagram.com/p/CZumZrnOzMP/	10873	471392	119748	616	0.449	0.449	0.445	FALSE
nature	-0.891147589	animalplanet	https://www.instagram.com/p/CZGUYt9oZqP/	1363	313294	17762	98	0.449	0.449	0.445	TRUE