

# Optimizing Social Media Engagement

*A Data-Driven Analysis of UNICEF NL's Communication Strategy*

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## EXECUTIVE SUMMARY

*Optimizing Social Media Engagement: A Data-Driven Analysis of UNICEF NL's Communication Strategy*

Social media plays a crucial role in helping UNICEF NL raise awareness, connect with audiences, and promote its mission. However, engagement levels vary widely across posts — some receive significant attention, while others generate little response. Understanding what drives this variation is essential for improving communication strategies and ensuring that messages resonate effectively with the target audience. This report investigates how different types of content, message framing styles and visual elements influence engagement on UNICEF NL's social media platforms, particularly Facebook and Instagram. Using a combination of machine learning techniques and statistical analysis, the study identifies the factors most strongly linked to user reactions, comments and shares. Based on these insights, practical recommendations are provided to help UNICEF NL refine its continent strategy and increase engagement.

The analysis reveals several important findings regarding the factors driving social media engagement for UNICEF NL. Posts that present factual information consistently generate higher levels of engagement compared to emotionally driven or narrative-focused content, indicating that audiences value informative and credible posts. Furthermore, negatively framed posts — particularly those that highlight urgent challenges or critical issues — tend to attract significantly more engagement, especially in the form of shares, as they appear to encourage both discussion and content sharing. Visual design also plays a critical role, with posts that feature warm colors, such as red and orange, outperforming those with cooler or neutral tones. Additionally, images with either very high or very low luminance generate stronger engagement than those with medium brightness, which seem to struggle to capture attention. The analysis also shows that sponsored posts consistently receive lower engagement than organic posts, suggesting that audiences may perceive paid content as less authentic. Finally, historical engagement patterns emerge as a key predictor of future performance, with posts that performed well in the previous week showing a greater likelihood of continued success, emphasizing the importance of maintaining content momentum.

Based on these findings, several recommendations are proposed to enhance UNICEF NL's social media strategy. It is advised to focus on producing factual, informative content that highlights UNICEF's work, progress, and impact, while incorporating emotional elements only when they add

meaningful context or enhance storytelling. Negative framing should be used strategically to emphasize urgency and draw attention to pressing issues, while ensuring that posts also present constructive solutions to maintain a sense of balance and avoid audience fatigue. Attention should also be paid to visual design, favoring warm colors and avoiding medium-brightness images, which tend to be less effective in capturing audience interest. Given the reduced engagement associated with paid promotions, organic content that feels natural and authentic should be prioritized, with sponsored posts carefully designed to align with UNICEF NL's broader storytelling approach. Additionally, high-performing content should be repurposed and refreshed by updating visuals, adding new information, or adjusting calls to action while retaining the core elements that previously resonated with the audience. Finally, tailoring content to platform-specific preferences, such as using visually compelling posts for Instagram and more detailed informational posts for Facebook, will help optimize engagement. Posting content at times when historical engagement is highest, combined with clear and concise captions that immediately highlight key information, will further enhance visibility and interaction.

By incorporating these evidence-based recommendations, UNICEF NL can enhance its social media strategy and create content that not only reaches wider audiences but also encourages meaningful interaction. With a stronger focus on factual content, strategic framing, and optimized visuals, UNICEF NL can ensure that its social media presence supports its broader goals of raising awareness, encouraging donations, and advocating for children's rights.

## INTRODUCTION

In today's digital landscape, social media serves as a vital tool for non-profit organizations such as UNICEF NL to raise awareness, engage with audiences, and drive meaningful impact. However, social media engagement levels vary significantly, some posts receive thousands of reactions, shares, and comments, while others fail to capture audience attention. This variation raises an important question: which factors influence engagement in UNICEF NL's social media posts, and how can this understanding improve communication strategies?

Engagement on social media is shaped by multiple factors, including content framing, message framing, and visual design. Understanding these elements is essential for optimizing UNICEF NL's social media approach, ensuring that messages not only reach a broad audience but also resonate effectively. Increased engagement enhances visibility through platform algorithms while also strengthening public awareness, donor participation, and overall organizational impact.

This study examines three core research questions to identify the primary drivers of engagement. First, it investigates whether factual or emotional content generates higher interaction, determining whether audiences engage more with data-driven, informative posts or narrative-driven, emotionally charged messages. Second, it explores how positive versus negative message framing affects engagement, assessing whether audiences respond more to hopeful, solution-oriented messages or problem-focused, urgent content. Lastly, it evaluates the impact of visual elements such as color and luminance to determine whether specific design choices enhance audience engagement.

To answer these research questions, a data-driven analysis of UNICEF NL's social media posts was conducted, employing machine learning techniques (Random Forest models) and statistical modeling (Linear Regression). Engagement was evaluated through three key metrics: reactions, comments, and shares. Given that some engagement metrics exhibited skewed distributions, log transformations were applied to ensure statistical accuracy. Additionally, Partial Dependence Plots (PDPs) were utilized to visualize the effects of specific variables, while feature importance rankings identified the most influential factors shaping engagement.

The following sections present the key findings and insights derived from the analysis, alongside practical recommendations aimed at enhancing UNICEF NL's social media strategy. The subsequent sections outline the methodological approach, results, and discussion, concluding with data-driven recommendations to improve engagement. By identifying the most influential factors, this study provides UNICEF NL with evidence-based strategies to enhance the effectiveness of its social media communication, ensuring that its messages inform, engage, and inspire action.

## LITERATURE REVIEW

Social media engagement plays a critical factor for organizations such as UNICEF NL, as it determines the reach and impact of their messages. Prior research has identified various factors influencing engagement, including content framing, message framing, and visual characteristics. Understanding these elements is essential for optimizing communication strategies and enhancing audience interaction. One of the central debates in digital engagement is whether factual or emotional content generates higher interaction. While emotional appeals have been extensively studied for their ability to provoke reactions (Stieglitz & Dang-Xuan, 2013), findings from this study indicate that factual posts outperform emotional ones in the context of UNICEF NL. Informative content enhances credibility and supports knowledge-sharing, which contributes to higher engagement (Kim & Kim, 2020). This aligns with research suggesting that audiences respond positively to value-driven content that provides clear insights and data (Koch, 2019).

The way messages are framed also plays a significant role in engagement. Framing theory suggests that the presentation of information influences audience responses (Entman, 1993). The results of this study confirm that negative framing is more effective in driving engagement compared to positive messaging. This finding is consistent with research indicating that messages emphasizing urgency or societal challenges encourage discussion and sharing (Tversky & Kahneman, 1981; Das et al., 2008). While positive framing is often linked to long-term relationship-building, the analysis found that it was less effective in generating immediate engagement.

Visual elements are another crucial component of engagement, as color and luminance affect how content is perceived and interacted with. The analysis reveals that warm colors, such as red and orange, significantly enhance engagement, supporting previous findings that these tones create a sense of urgency and attract attention (Labrecque et al., 2013; Valdez & Mehrabian, 1994). Meanwhile, neutral and cool colors were associated with lower engagement, reinforcing the impact of color psychology on digital interactions. Regarding luminance, medium brightness levels showed the lowest engagement, whereas both high and low luminance levels performed better. These findings are consistent with research suggesting that extreme luminance levels create stronger contrasts, which effectively capture user attention (Pieters et al., 2010).

Beyond content and visuals, historical engagement trends also influence the success of social media posts. Social media algorithms prioritize content that has previously performed well, making past engagement a strong predictor of future success. The results of this study support this notion, as last week's engagement metrics significantly influenced current engagement levels, aligning with research on algorithm-driven content promotion (Bakshy et al., 2011). Additionally, the analysis found that sponsored posts negatively impact engagement, likely due to the perception of inauthenticity in paid content. This observation aligns with existing literature indicating that organic engagement tends to be stronger than paid promotion, particularly for non-profit messaging, as audiences are more inclined to interact with content perceived as genuine (Taylor et al., 2011).

Overall, the findings confirm that engagement is influenced by a combination of content framing, message framing, and visual design. Factual posts generate higher engagement than emotional ones, negative framing leads to stronger audience reactions, and warm colors enhance visibility and interaction. Additionally, past engagement serves as a reliable predictor of future performance, while sponsorship reduces organic interaction. These insights provide actionable guidance for UNICEF NL, assisting in the refinement of social media strategies to maximize audience engagement and impact.

## DATA DESCRIPTION

The dataset used in this study, titled *social\_media\_postings*, was provided by UNICEF NL. It contains 1,645 observations and 65 variables, with each observation corresponding to a social media post made by UNICEF across platforms such as Facebook and Instagram. The dataset includes a wide range of details about each post, including engagement metrics, textual content, time and date of publication, and classification attributes. The dataset contains several types of variables that form the basis for this study. The engagement variables include metrics such as reactions, shares and comments. Posting date and time provide insight into posting trends and audience behavior. The chosen dependent variables — reactions, comments, and shares — capture different ways users engage with UNICEF NL's social media posts. Reactions provide a quick sense of how people feel about a post, while comments show when users are motivated to join the conversation or share their own thoughts. Shares, on the other hand, reflect how willing people are to pass the content along to their own networks. Together, these three measures offer a well-rounded view of how audiences are interacting with UNICEF NL's content, from simple clicks to deeper forms of engagement. Other crucial variables include content-based attributes, such as post type (photo, video, or text), platform type, and textual elements extracted from post captions. Additionally, the dataset includes links to the original posts, which allowed for the extraction of image-related attributes for further analysis. To enhance the dataset, additional variables were constructed to represent visual characteristics, message and post framing, and engagement trends. These newly generated variables enable a deeper exploration into the impact of post features on engagement outcomes.

## VARIABLE CONSTRUCTION AND FEATURE ENGINEERING:

### TEXT ANALYTICS AND SENTIMENT ANALYSIS

Since text content plays a significant role in engagement, a series of preprocessing steps was applied to analyze post captions effectively. The dataset was originally in Dutch, so all posts were translated into English. After translation, text preprocessing techniques were applied, including converting all text to lowercase, removing punctuation, eliminating numbers, and standardizing spacing. These preprocessing steps ensured that all text-based features were uniform, reducing unnecessary noise and improving analytical accuracy. Following text preprocessing, sentiment analysis was conducted using the Syuzhet package, assigning each post a sentiment score ranging from -1 (strongly negative) to 1 (strongly positive). To ensure consistency and comparability across posts, min-max normalization was applied, preserving the relative intensity of emotions while facilitating meaningful insights.

## FRAMING VARIABLES

Once sentiment analysis was complete, two categorical variables were created based on the sentiment score: content framing and message framing. The content framing variable was designed to distinguish between factual and emotional posts. Posts with sentiment scores greater than an absolute value of 0.19 were categorized as emotional, while those with sentiment scores below this threshold were categorized as factual. This distinction allowed for the examination of whether emotionally driven content generated higher engagement compared to factual posts. In addition to categorizing posts by emotional intensity, a message framing variable was created to classify posts as either positive or negative based on sentiment polarity. Posts with sentiment scores greater than zero were labeled as positive, while those with scores below zero were categorized as negative. This classification enabled the investigation of how the tone of the message influenced engagement levels, particularly in relation to audience reactions, shares, and comments.

## VISUAL CHARACTERISTICS (COLOR AND LUMINANCE)

One of the most important aspects of the analysis involved understanding the effect of a post's visual characteristics on audience engagement. To achieve this, information about color composition and luminance was extracted from the images attached to the posts. First, a Python script was developed to access the URLs present in the dataset and download the images associated with each post. A second Python script was then applied, utilizing the Google Vision API to analyze these images and identify the dominant colors in each one. The RGB\_dominant score was extracted, indicating the dominant color of each image. Based on these values, each post was categorized into one of three color categories: warm, cool, or neutral. Warm colors included red, orange, and yellow, which are typically associated with urgency and emotional impact. Cool colors, such as blue and green, are more often linked to calmness and stability. Neutral colors consist of black, white, gray, and brown, which tend to convey balance and professionalism. In addition to color categorization, a luminance variable was created to measure the brightness of each image. Luminance was calculated using the formula as follows:

$$\text{Luminance} = 0.299 \times R + 0.587 \times G + 0.114 \times B$$

Once the luminance values were obtained, they were categorized into three groups: low luminance (values below 100), medium luminance (values between 100 and 175), and high luminance (values above 175). This can be seen whether the brightness of an image played a role in engagement levels.

## CONTROL VARIABLES

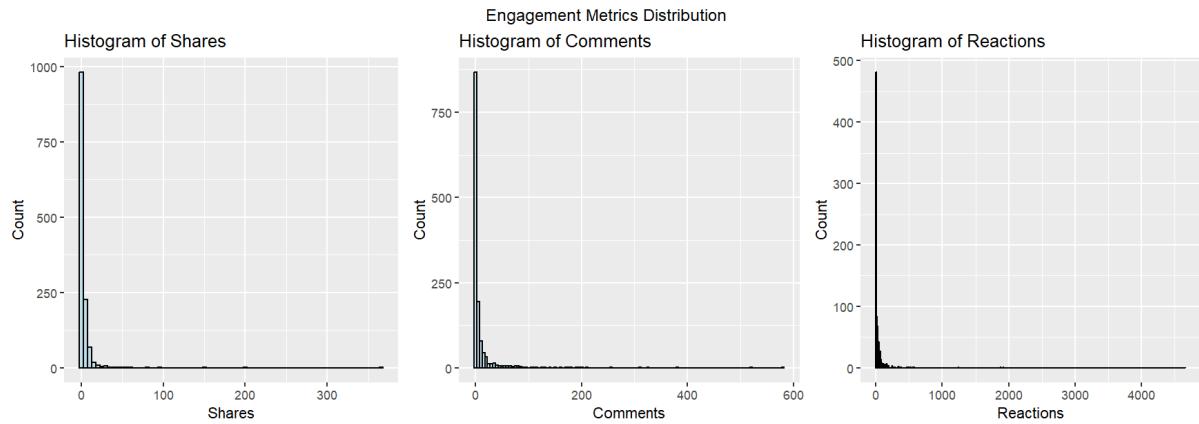
To make the analysis robust and reliable, a set of control variables were included that accounted for external factors influencing engagement. Firstly, missing data were handled by removing unnecessary variables such as video views and link clicks, which were not relevant to the study. Missing values in key engagement variables, such as reactions and shares, were either removed or imputed using the median to minimize data loss. Derived variables were also created to track engagement trends over time. Specifically, past week engagement metrics were computed, which involved calculating rolling sums of the previous week's reactions, comments, and shares. This helped to check whether past engagement levels influenced future interactions with UNICEF NL's posts. Furthermore, a post sponsorship indicator was created, which is a binary variable that distinguishes between sponsored and organic posts. This helped to determine whether paid promotions affected engagement differently than non-sponsored content. Another binary variable, weekend indicator, was added to differentiate between posts published on weekdays and weekends, as engagement patterns may vary based on the day of the week. Finally, a text length variable was generated, which measures the total number of characters in each post, to help to analyze whether longer posts generate higher engagement. To address the skewness in engagement metrics, it was applied a log transformation to variables such as reactions, comments, shares, using the `log1p()` function. This transformation provided a more normalized distribution, preventing extreme values from influencing the results.

## DATA PREPARATION

Once all necessary variables were created, additional data preparation steps were taken to ensure the dataset was ready for analysis. First, all irrelevant variables were removed that did not contribute to the research. Then duplicate observations were eliminated.

Next, missing values were addressed by removing entries with NA values in critical variables essential to the analysis. For engagement metrics, such as shares and comments, the median imputation method was applied to fill in missing values. These steps ensured the dataset was clean, consistent, and ready for robust statistical and machine learning analysis.

As part of preparing the data for analysis, a closer examination of the distribution of the engagement metrics (reactions, comments, and shares) was conducted. The histograms below clearly showed that all three metrics were heavily skewed, with most posts receiving only a small number of interactions and just a few posts performing exceptionally well.



To address this positive skewness, a log-transformation was applied to each engagement metric. This transformation helped to compress the long tails of the distributions, making the data easier to work with and ensuring the models could more reliably capture relationships between variables. In addition to these transformations, an assessment was conducted to check whether specific types of posts, such as those belonging to certain content categories or framing groups, were overrepresented in the dataset. Thankfully, the different content and framing categories were fairly balanced, meaning that no single type of post had an outsized influence on the results.

Finally, to better understand the composition of the dataset, the distribution of key categorical variables was examined. The graphs below display the class distributions for Content Framing (factual vs. emotional), Message Framing (positive vs. negative), Color Category (warm, cool, neutral), and Luminance Category (low, medium, high).



The distributions show that Content Framing and Message Framing are relatively balanced, meaning both factual and emotional posts, as well as positive and negative messages, are well represented in the dataset. However, there is some imbalance in the Color and Luminance categories, with cool colors and medium luminance being much more frequent than other categories. While this does not prevent analysis, it is important to note that insights related to neutral colors or high luminance should be interpreted with caution, as these categories contain fewer observations. This class imbalance could limit the model's ability to detect reliable patterns for underrepresented categories.

After completing all preprocessing steps, variable creation, and data cleaning procedures, the final dataset consists of 1,320 observations and 43 variables. This structured approach to data preparation ensures that the dataset is clean, normalized, and enriched with valuable features, enabling a comprehensive analysis of engagement patterns across different types of posts. Below is an overview of the variables included in the final dataset.

	<b>Variable Name</b>	<b>Definition</b>
<b>Dependent Variables:</b>	“log_reactions”	Log-transformed number of reactions (likes, loves, etc.) on the post
	“log_comments”	“Log-transformed number of comments on the post
	“log_shares”	Log-transformed number of times the post was shared
<b>Visuals:</b>	“luminance_category”	Categorization of brightness levels (Low, Medium, High)
	“color_category”	Categorization of dominant color in the image (Warm, Cool, Neutral)
<b>Emotional Appeals:</b>	“content_framing”	Classification of post as emotional or factual
<b>Sentiment:</b>	“message_framing”	Classification of post as positive or negative
<b>Control Variables:</b>	“is_sponsored”	Indicator for whether post was paid promotion (0 = Organic, 1 = Sponsored)
	“network”	Social media platform where the post was published
	“last_week_engagement_metric”	Engagement level from the previous week
	“is_weekend”	Indicator for whether the post was published on a weekend (0 = Weekday, 1 = Weekend)
	“content_type”	Format of the post (e.g., Link, Image, Video)
	“text_length”	Number of characters in the post

## METHODOLOGY

After preparing the data and creating relevant features, the study applied machine learning and statistical techniques to identify key factors influencing engagement. To better understand the factors driving engagement in UNICEF NL's social media posts, this study employs a data-driven approach, integrating text analysis, sentiment analysis, and machine learning techniques. The methodology consists of feature engineering, predictive modeling using Random Forest and linear regression, and an analysis of feature importance to identify the key factors influencing engagement.

A critical component of this process involves text and sentiment analysis to categorize social media posts. Text analysis is utilized to classify content, distinguishing between factual and emotional posts, as well as identifying different message framings (positive vs. negative). Sentiment analysis further refines this classification by detecting the emotional tone of each post, providing deeper insight into how different messaging styles impact audience interaction. Existing research supports this approach, as sentiment analysis has been widely used to examine audience responses to online content (Yadav & Vishwakarma, 2020). Studies such as *A Survey on Sentiment Analysis Methods, Applications, and Challenges* (Yadav & Vishwakarma, 2020) and *Detection of Emotion by Text Analysis Using Machine Learning* (Cambria et al., 2022) highlight the effectiveness of these techniques in capturing audience sentiment and engagement patterns. The implementation of these methods ensures a structured and data-driven evaluation of UNICEF's messaging strategies.

To model engagement trends, this study employs Random Forest and linear regression models. Random Forest, a machine learning algorithm that constructs multiple decision trees, is selected for its ability to handle large datasets, manage noisy data, and identify the most influential predictors of engagement (Breiman, 2001). This technique has been effectively applied in previous studies focused on engagement prediction, such as *Application of Machine Learning in the Social Network* (Zhang et al., 2021).

Alongside Random Forest, linear regression is applied to quantify the direct effects of various content characteristics on engagement metrics. This method provides statistical insights into the strength and significance of relationships between variables, particularly content type, message framing, and visual features. Regression models have been extensively used in social media engagement research, as noted in *A Survey on Sentiment Analysis Methods, Applications, and Challenges* (Yadav & Vishwakarma, 2020). Furthermore, linear regression is used as the baseline model in this study, providing a reference point for evaluating the performance of the more complex Random Forest model. By establishing a simple yet interpretable foundation, the linear regression model enables us to measure whether incorporating non-linear relationships and interactions through Random Forest leads to significant improvements in predictive accuracy. This comparison ensures that any observed enhancements in model performance are due to the machine learning approach rather than inherent patterns in the data.

The selection of Random Forest over other machine learning models, such as Support Vector Machines or Neural Networks, is motivated by its high interpretability and ability to work with both numerical and categorical data. While deep learning models like Convolutional Neural Networks (CNNs) provide strong predictive performance, their complexity makes them less suitable for this study, where understanding the impact of content characteristics is a priority (Zhang et al., 2021). The

combined use of Random Forest and linear regression allows for a balance between predictive accuracy and interpretability, ensuring that the findings are both actionable and explainable. This approach enables UNICEF NL to refine its social media strategy with clear, data-driven insights to maximize audience engagement.

## ANALYSIS AND RESULTS

The analysis began with a baseline model to gain initial insights into the key drivers of social media engagement. This model was made to check the factors influencing reactions, comments, and shares. Table 1 presents the regression results for each engagement metric, illustrating the relationships between post characteristics and audience interaction.

**Table 1: Linear Regression Results for Social Media Engagement**

	<i>Dependent variable:</i>		
	<b>log_reactions</b>	<b>log_comments</b>	<b>log_shares</b>
<b>content_framingFactual</b>	0.267*** (0.076)	0.130* (0.070)	0.148*** (0.046)
<b>message_framingPositive</b>	-0.100 (0.078)	-0.110 (0.072)	-0.134*** (0.047)
<b>luminance_categoryMedium</b>	-0.272*** (0.096)	-0.183** (0.088)	-0.199*** (0.058)
<b>luminance_categoryHigh</b>	-0.131 (0.117)	-0.087 (0.107)	-0.222*** (0.071)
<b>networkInstagram</b>	-0.052 (0.191)	-0.593*** (0.171)	-0.599*** (0.113)
<b>content_typeLink</b>	-0.140 (0.409)	0.255 (0.378)	0.492** (0.248)
<b>content_typePhoto</b>	0.336 (0.415)	0.499 (0.383)	0.699*** (0.252)
<b>content_typeVideo</b>	-0.139 (0.402)	-0.020 (0.371)	0.512** (0.244)
<b>is_sponsored</b>	-1.525*** (0.114)	-0.587*** (0.104)	-0.656*** (0.069)
<b>Color_CategoryNeutral</b>	0.963*** (0.241)	0.495** (0.221)	0.576*** (0.146)
<b>Color_CategoryWarm</b>	0.290*** (0.087)	0.352*** (0.080)	0.218*** (0.053)
<b>is_weekend1</b>	-0.230** (0.108)	-0.052 (0.100)	-0.087 (0.066)
<b>text_length</b>	0.0001 (0.0004)	-0.0001 (0.0004)	-0.0001 (0.0002)

<b>last_week_log_reactions</b>	0.056*** (0.005)		
<b>last_week_log_comments</b>		0.059*** (0.007)	
<b>last_week_log_shares</b>			0.056*** (0.006)
<b>Constant</b>	2.553*** (0.428)	0.902** (0.389)	0.531** (0.256)
<b>Observations</b>	1,320	1,320	1,320
<b>R<sup>2</sup></b>	0.443	0.194	0.310
<b>Adjusted R<sup>2</sup></b>	0.437	0.185	0.303
<b>Residual Std. Error (df = 1305)</b>	1.313	1.211	0.796
<b>F Statistic (df = 14; 1305)</b>	74.112***	22.392***	41.925***

*Note:*

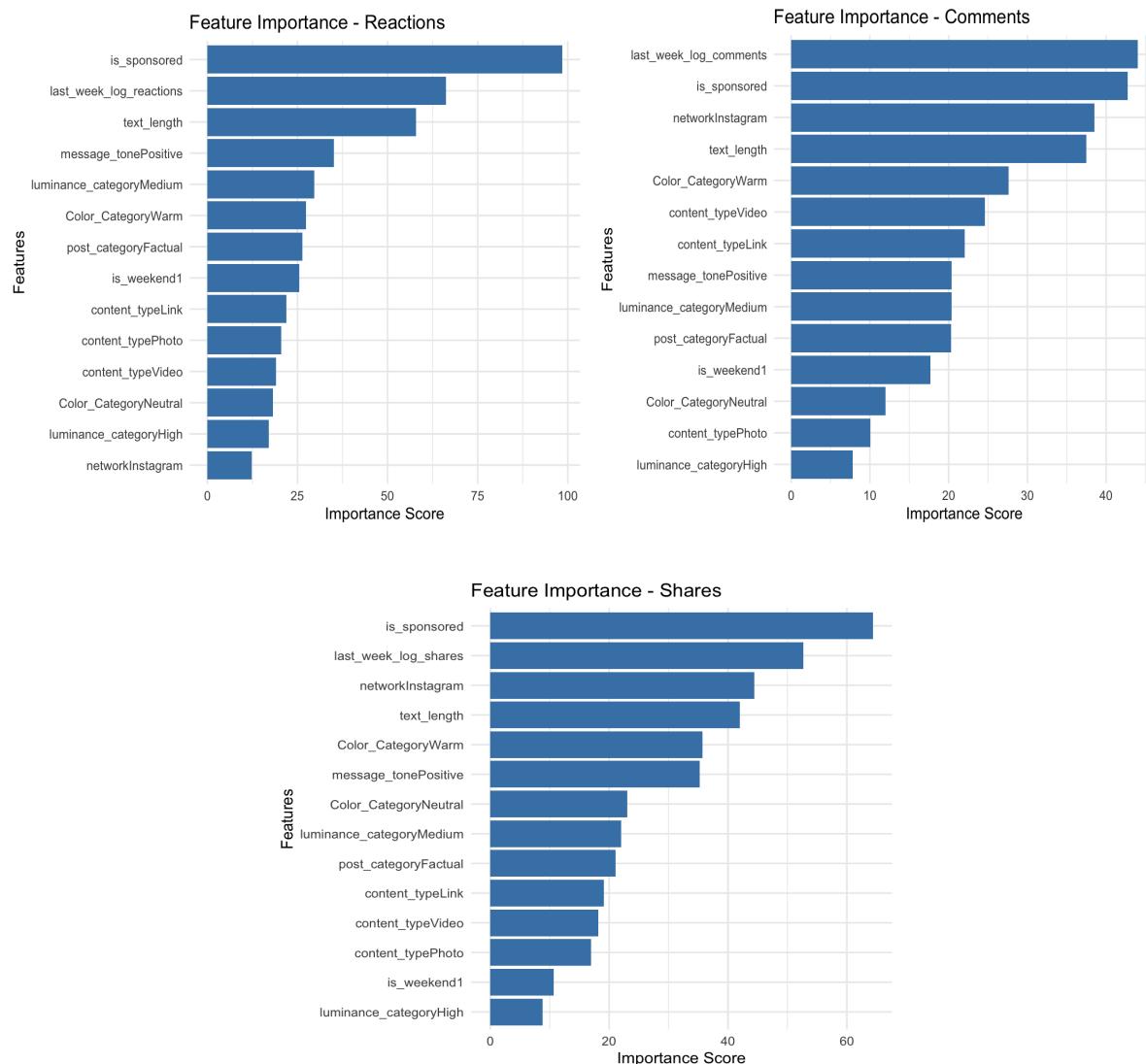
\*p \*\*p \*\*\*p<0.01

To start with, reactions, which represent a passive engagement metric, are primarily influenced by content framing, color category, and sponsorship. Fact-based content and posts with neutral or warm tones lead to higher reactions, suggesting that users respond positively to informative and visually balanced content. However, sponsored posts significantly reduce reactions, indicating that people may not like promoted content and tend to not react to it. Luminance also plays a role, with medium brightness levels negatively affecting reactions. Other factors, such as platform choice and content type, show no significant impact on this metric. Moving to comments, which reflect deeper audience engagement, are driven by content characteristics and platform type. Fact-based content, warm colors, and past engagement all contribute to higher comment volumes. However, Instagram posts receive significantly fewer comments than other platforms, highlighting differences in user interaction styles across networks. Sponsorship also negatively affects comments, boosting the idea that organic content encourages more discussion. In contrast, luminance effects are less pronounced for comments than for other engagement metrics.

Lastly, shares, the most impactful form of engagement, are strongly influenced by content framing, color category, luminance, and platform choice. Again, factual posts, neutral and warm tones, and well-balanced brightness levels encourage sharing, while positive message framing reduces shares, suggesting that users are more likely to distribute content that includes negative framing. Additionally, sponsored posts receive significantly fewer shares, and past engagement is a strong predictor of future shares, indicating the importance of maintaining content momentum. Visual content, particularly photos and videos, is more likely to be shared than text-based or link-driven posts. Overall, the findings suggest that while reactions are driven primarily by content type and aesthetics, comments are influenced by informativeness and platform-specific engagement styles, and shares depend on the credibility, emotional impact, and visibility of the post. These insights provide initial insights to optimize content strategies to enhance engagement across different metrics.

To further enhance the analysis, a Random Forest model was applied to identify the most influential factors driving engagement. The Random Forest analysis highlights key factors influencing engagement across reactions, comments, and shares. As shown below in the feature importance graphs, sponsorship is the strongest predictor, indicating that paid content significantly affects user

interactions. Past engagement also plays a major role, suggesting that posts that performed well previously continue to attract attention.

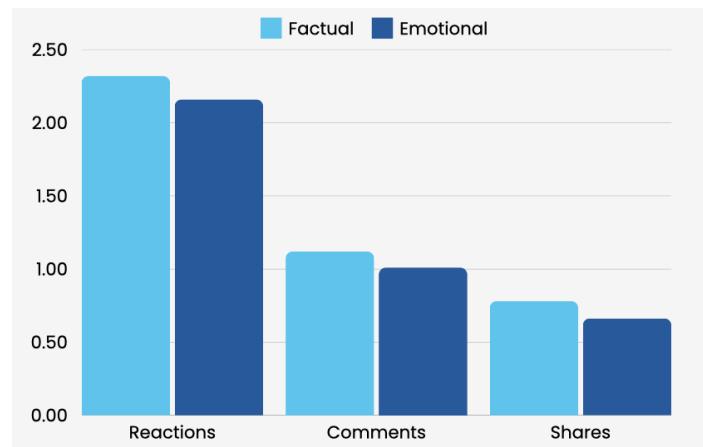


Random Forest Model Performance (%)			
Evaluation Metric	Reactions Model	Comments Model	Shares Model
Accuracy	81.8	64.3	75.3
F1-Score	76.5	55.7	69.5
Balanced Accuracy	81.2	65.4	77.8

Specifically, for reactions, the most important factors, apart from sponsorship and past reactions, are text length and message framing, suggesting that longer posts and the way messages are framed influence how users respond. Color category, especially warm tones, also plays a role, likely because warm colors evoke strong emotions. Luminance is moderately relevant, indicating that brightness

levels can subtly affect user reactions. Content framing is present but less significant. The model performed well, with 81.75% accuracy and 0.765 F1-score, demonstrating strong predictive ability. For comments, past engagement and sponsorship remain dominant, but platform choice (Instagram) also plays a role, as Instagram users engage differently in discussions. Message framing and content framing have moderate influence. Warm colors also appear relevant, likely because they attract attention and make content feel more engaging. Luminance has a smaller effect here, indicating that brightness does not strongly drive discussions. The model's moderate performance, 64.26% accuracy and 0.557 F1-score, is not as strong as the previous model but it still remains strong. The next model includes shares. As it is shown, past shares, sponsorship, and text length are the strongest predictors, emphasizing the importance of virality momentum. Message framing and content framing show moderate impact, suggesting that emotionally engaging and factual posts are more likely to be shared. Color category (warm and neutral tones) also matters, as visually appealing content tends to spread more. Luminance (especially medium levels) appears significant as well. The model performed well with 75.29% accuracy and 0.695 F1-score, making it a reliable predictor of sharing behavior. Overall, sponsorship, past engagement, and text length have the most impact on engagement levels, while message framing, content framing, color category, and luminance play moderate but meaningful roles. The models predict reactions and shares well, while comments remain harder to anticipate, likely due to the complexity of user discussions.

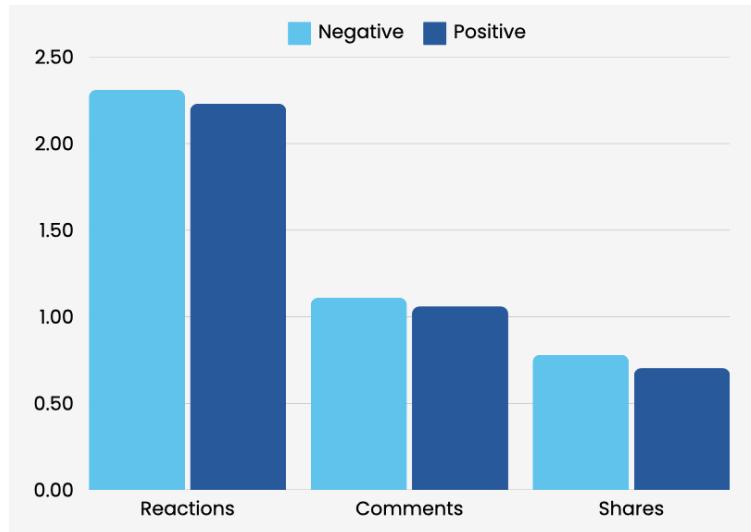
To better understand the role of key variables, Partial Dependence Plots (PDPs) were used to isolate the created variables and their individual effects, beginning with content framing. The PDP plot below illustrates the impact of content framing on engagement metrics, including reactions, comments, and shares. The bars depict the average predicted engagement levels for posts framed as factual (light blue) versus emotional (dark blue).



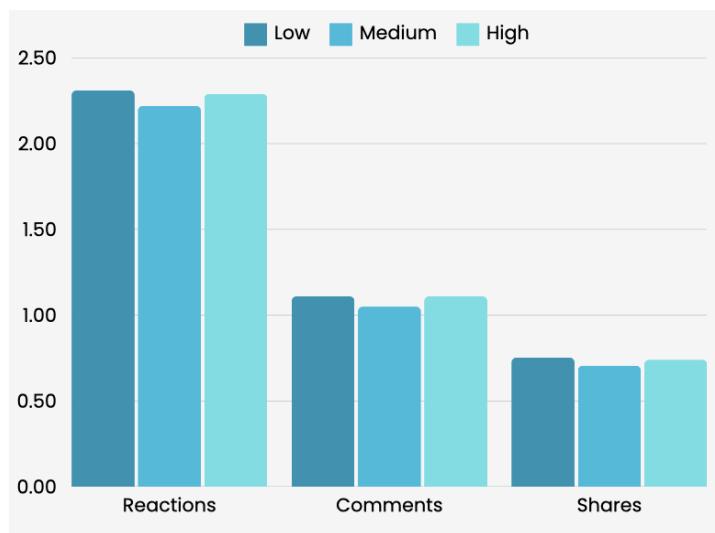
The analysis indicates that factual content consistently outperforms emotional content across all engagement metrics. Findings from the Random Forest model highlight the significance of content framing, particularly for reactions, followed by shares and comments. This suggests that while factual content primarily drives immediate interactions, deeper engagement, such as sharing and commenting, is influenced by additional factors including content type, sponsorship, and platform. The stronger effect on reactions implies that audiences perceive factual posts as more credible and informative, prompting quicker responses, whereas shares and comments may require more emotional or

contextual appeal. Overall, while factual content enhances engagement across all metrics, its impact varies, highlighting the importance of integrating other strategic elements when optimizing content performance.

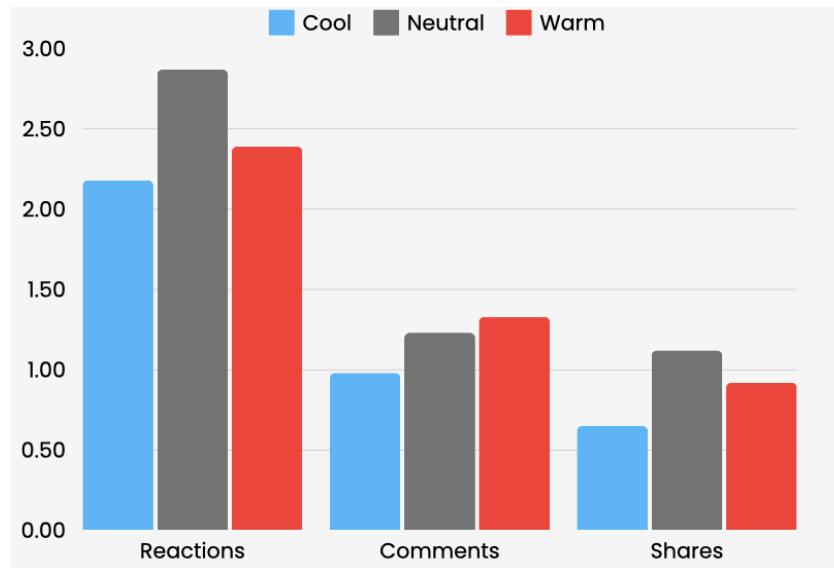
Next, the analysis of message framing examined the impact of positive and negative tones on engagement. The Partial Dependence Plots show the impact of message framing across all engagement metrics.



While both framing styles produce similar effects on reactions and comments, negative framing demonstrates a slightly greater influence on shares. Message framing ranks among the most influential factors for both reactions and shares, emphasizing its critical role in shaping user interactions. These findings suggest that while positive tones contribute to a favorable reception, negative messaging is more effective in driving engagement. This indicates that audiences may be more inclined to interact with content that evokes critical reflection or urgency rather than one that conveys purely positive sentiment. The analysis now turns to the visual impact of social media content, beginning with luminance and extending to other visual elements, such as colors. Luminance, which refers to the brightness of an image, plays a significant role in influencing user engagement.



The Partial Dependence Plots (PDPs) and Random Forest model results indicate that medium luminance levels generally reduce engagement across all metrics. Specifically, medium luminance demonstrates a consistent negative effect, suggesting that moderately bright images may lack the visual appeal needed to capture users' attention in a crowded social media feed. These findings emphasize the need for a balanced approach to brightness. Following luminance, the analysis will explore the effects of color category to provide an explanation of how visual elements contribute to social media performance.



The analysis reveals that neutral and warm-toned content significantly enhances engagement across reactions, comments, and shares. Neutral colors, in particular, emerge as one of the strongest predictors of engagement, ranking high in importance within the Random Forest model. Their positive effect suggests that balanced and subdued tones create a sense of professionalism and credibility, making the content more appealing. Warm colors also contribute positively to engagement, supporting the idea that colors such as red, orange, and yellow evoke strong emotional responses, leading to increased interactions. The results highlight the importance of choosing colors thoughtfully, as they shape how users perceive content and influence how they engage with it.

## DISCUSSION

Based on the analysis of UNICEF NL's social media engagement, several key recommendations are proposed to optimize content strategies and maximize audience interaction. The findings indicate that factual posts consistently outperform emotional ones in driving engagement. While emotional storytelling can evoke strong reactions, audiences tend to interact more with content that provides valuable information and credibility. To leverage this, UNICEF NL is advised to focus on educational and data-driven content that informs the audience about UNICEF's work, progress, and the impact of donations. Factual posts should be supplemented with emotional elements when relevant, but the

primary focus should remain on providing clear, informative insights. Compelling statistics, expert opinions, and real-world case studies can further establish credibility and encourage sharing.

Posts that highlight urgent challenges and pressing issues generate higher engagement than purely positive messaging. This aligns with previous research showing that problem-focused messages drive action and discussion. Messages should be framed to highlight critical issues while maintaining a solutions-oriented approach. Using strong, action-oriented language that encourages users to share posts and participate in discussions is recommended. However, it is also important to balance negative framing with actionable takeaways to prevent disengagement caused by overly distressing content.

Visual elements significantly influence engagement, with warm colors such as red, orange, and yellow, as well as high luminance, contributing to increased interaction levels. To optimize visual design, warm colors should be prioritized in imagery, infographics, and branding elements to capture attention. Medium-luminance images should be avoided, as they were found to have the lowest engagement levels. Instead, either high-luminance (bright) or low-luminance (dark contrast) visuals should be used. Ensuring that images stand out in social media feeds by maintaining strong color contrast and clear focal points can further enhance visibility and interaction.

Paid promotions were found to negatively impact engagement, as users often perceive them as less authentic than organic content. To mitigate this, it is recommended that UNICEF NL reduce reliance on direct promotional posts and instead focus on organic reach strategies. When paid advertising is used, storytelling-based ads that feel natural and engaging rather than explicitly promotional should be prioritized. Additionally, conducting A/B testing on different ad formats can help identify messaging styles that resonate best with audiences while maintaining authenticity.

Social media algorithms favor posts that have previously performed well. The momentum effect indicates that posts with high engagement in one week are more likely to perform well in subsequent weeks. UNICEF NL should identify top-performing content and replicate key elements such as format, framing, and visuals in future posts. High-engagement posts can also be recycled with slight variations, such as updated information, new visuals, or different calls to action. Implementing A/B testing to experiment with variations of successful posts can further refine content strategies.

Engagement behaviors were found to vary across platforms such as Facebook and Instagram, meaning that a one-size-fits-all approach may not be effective. It is recommended that UNICEF NL analyze platform-specific trends and customize content accordingly, such as using visual-heavy posts for Instagram and detailed informational posts for Facebook. Adapting content length and formatting to suit platform preferences can enhance readability and shareability. Additionally, scheduling posts based on optimal engagement times identified through historical analysis can help maximize reach.

Text length also plays a significant role in engagement, with longer posts sometimes reducing user interaction. To optimize post length and content structure, captions should be kept concise yet informative, ensuring that key messages appear within the first few lines. Structured formats such as bullet points or short paragraphs can enhance readability. Experimenting with different post lengths can help determine the optimal balance for audience engagement.

To apply these recommendations effectively, UNICEF NL should establish a structured content strategy. A content planning approach should be developed, incorporating these insights into an editorial calendar that ensures a mix of factual and emotionally appealing content with strong visuals. Performance should be monitored regularly by analyzing engagement trends and refining strategies

based on audience preferences. A/B testing should be conducted to experiment with different messaging, framing, and visual styles to identify the most effective engagement drivers. Furthermore, content strategies should be tailored for different social media platforms to maximize reach and impact. By integrating these recommendations, UNICEF NL can enhance its social media strategy, ensuring that its messages effectively inform, engage, and inspire action among its audience. Together, these evidence-based recommendations provide UNICEF NL with actionable strategies to enhance social media performance, ultimately supporting its broader communication and advocacy goals.

## CONCLUSION

The findings of this research provide UNICEF NL with concrete insights into optimizing its social media strategy to maximize engagement. By analyzing the impact of content framing, message framing, and visual content, the study identified key elements that drive user interaction. Factual posts were found to be more engaging than emotional ones, reinforcing the importance of providing informative and data-driven content. Negative framing emerged as a strong driver of engagement, as it generates urgency and discussion, while visual aspects such as warm colors and high luminance enhance visibility and interaction. Additionally, the analysis showed that organic content consistently outperforms sponsored posts, underlining the need for a strategic, narrative-driven approach rather than direct advertising.

The results also highlight the importance of momentum in social media engagement, as posts with high interaction levels tend to continue performing well. This suggests that UNICEF NL should capitalize on successful content formats and themes, reinforcing engagement over time. The feature importance analysis further confirms the significance of elements such as past engagement trends, post characteristics, and text length in determining the effectiveness of social media posts.

By implementing these insights, UNICEF NL can refine its content strategy, focusing on evidence-based approaches to maximize audience engagement. Leveraging these findings will not only enhance social media visibility but also strengthen the organization's ability to spread awareness, inspire action, and ultimately support its mission of advocating for children worldwide.

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