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# The Arc de Triomphe, Wrapped: Measuring Public Installation Art Engagement and Popularity through Social Media Data Analysis

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**Abstract:** Social media is the most popular canvas to engage with art. In this study, we provide a different angle, on how an artistic installation on a world-renowned monument—such as Paris' Arc de Triomphe—can emotionally affect viewers and potentially increase the popularity of the artwork. We collected $N$ = 7078 Instagram and $N$ = 3776 Twitter posts of the Arc de Triomphe as wrapped (installation) and unwrapped using APIs. As engagement indicators for several supervised machine learning experiments, we chose the total number of likes, comments, shares, text sentiment, and so on. Our findings revealed that people were captivated by the poetic installation. Based on the results, we discovered that the sentiments of triumph and surprise prevailed in datasets of the Arc de Triomphe as unwrapped. The same sentiments of triumph and surprise were most prevalent in datasets as wrapped, as well, but with higher scores. Furthermore, we have provided evidence of public art experience and engagement in the social media era. This research, we believe, will be useful in future studies of social media through the lens of public art and popularity. We hope that our findings will stimulate future research in the fields of art curatorship, cultural heritage management, marketing and communication, aesthetics, and culture analytics.

**Keywords:** Instagram; Twitter; aesthetic experience; installation art; public art; popularity; machine learning; data analysis

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## 1. Introduction

The widespread acceptance of the internet, artificial intelligence, and new media applications has contributed to the establishment of a new aesthetic culture [1,2]. The pandemic crisis of COVID-19 has changed social media consumption behavior. In particular, Instagram has been quickly gaining popularity in recent years among other applications [3] due to its eye-candy interface [4]. On the contrary, Twitter is also a popular micro-blogging platform [5,6] that is ideal to promote art, but it has a more informative design and textual nature than Instagram. Its users are more concerned with the latest news or trends around the world, meaning-making, and discussions [7]. Kinfolk and Cereal [8] magazines promote simplicity and elegance in the same way that Instagram does. A growing number of Instagram influencers across the board are adopting their minimal creative aesthetics in art, design, and style [9]. During and after the lockdown, we observed an expansion of Instagram posts generally [10], as well as photographs of monuments or museum exhibits.

Recently, considerable attention has been paid to the recovery of tourism cultural products after the uncertain lockdown period. Several memory institutions, such as museums and other heritage centers [11], were forced to shut down temporarily as a result of government constraints placed globally in response to the COVID-19 pandemic outbreak [12]. Quite a few destinations globally have blocked tourist entrance, attempting to force them to stay at home and postpone their travel and entertainment desires [13]. This had a dramatic impact on various sectors, such as work–life balance [14], and especially on the tourism economy, including the leisure industry [15], aviation [16], the hotel business [17], and

artistic creativity. However, after the lockdown was lifted, we observed an increase in trips to popular destinations as a "revenge travel" phenomenon [18]. Similarly, visits to art sites, museums, and attractions indicate a post-COVID revival [19] while reopening ensuring the safety of their visitors.

Two years ago, due to the sheer physical isolation of the pandemic, museum visits shifted from the natural to the digital creative environment [20–22]. During the lockdown period, Instagram also claims that over 500 million people used stories daily, outweighing other social media statistics like Snapchat stories [15]. Twitter users, on the other hand, expressed their feelings about pandemic concerns [23]. Broadly speaking, in the post-COVID era, cities are improving their image in order to re-enter the tourist market. Travelers are drawn to history, culture, monuments, and gastronomy. Nevertheless, cleanliness, accurate information, and convenient transportation can enhance the tourist and aesthetic experience overall [24]. In this paper, we offer a fresh perspective on the way in which an artistic installation on a world-renowned monument like the Arc de Triomphe in Paris can emotionally affect viewers. We also take a glance at how the aesthetic experience can be expressed on social media like Instagram and Twitter in order to increase the artwork's popularity. The remainder of the paper is organized as follows: Section 1 includes the introduction, aim, and research questions of the study. In Section 2, the related work about the topic will be discussed. Section 3 is devoted to the methodology. Section 4 presents the implementation and the experimental results. Section 5 presents the limitations. The conclusion and further research are reported in Section 6.

*Aim and Research Questions*

The art experience is a personal, dynamic, and emotionally stimulating process [25]. As an effect of the widespread use of social media networks, the art experience has shifted from the physical museum setting to the digital realm [4]. Previous research, such as Leaver, Highfield, and Abdin [26], has emphasized the Instagram philosophy, which includes marketing, creativity, and regular use, as well as finance and cultural reception. A swift scroll on Instagram and Twitter offers posts about the latest news [27] and trends in real-time, such as COVID-19 [28,29], fashion and style [30,31], way of life [32], self-image presentation [33], and of course arts and culture [34,35]. Instagram and Twitter micro-influencers also exist, having 336 million monthly active users [36]. In fact, it has been discovered that influencers directly impact approximately 40% of purchases through word-of-mouth marketing campaigns [37]. Twitter is commonly used by organizations to preserve and encourage their digital presence [38].

The posts on both platforms also include monument photographs and public artworks sharing, and we did not find any previous work on the Arc de Triomphe as Wrapped, a contemporary installation artwork by Christo and Jeanne-Claude. Hence, we conduct for both Instagram and Twitter datasets classification tests to investigate the impact of monuments and public art attractiveness in the social media sphere. This paper aimed to respond to four research questions (RQs) about how installation art could elicit emotions that influenced popularity, out of several machine learning tasks. All of the questions are sentiment-based, and are related to the popularity of the Arc de Triomphe monument posts wrapped and unwrapped:

Classification Tasks for the Instagram and Twitter Datasets:

- RQ1: What sentiments inspire people to share monuments on social media?
- RQ2: What is the relationship between users' reactions and sentiment regarding the Arc de Triomphe monument?
- RQ3: What is the relationship between users' reactions and sentiment regarding the "Arc de Triomphe Wrapped" Installation art?
- RQ4: In which of the two cases were people photographed with the monument more frequently? Does this affect popularity?

The age of social media has had a significant impact on how we interact with monuments and public art. The originality of our research is the association between the photo

content and user reactions to the Arc de Triomphe of Paris before and after the installation art by Jeanne-Claude and Christo titled "Arc de Triomphe Wrapped". Traveling and art sharing on social media have been elevated since the end of the COVID-19 pandemic's lockdown. This was an excellent opportunity to investigate the art engagement on Instagram and Twitter. Daily, a large number of influencers, as microcelebrities, post images of themselves [26,39,40] in front of monuments and other cultural attractions. Through their accounts, they demonstrate an extravagant lifestyle. Besides this, we hope that our findings will provide valuable insights into how public installation art may become popular on social media platforms. Museologists, social media scientists, art marketers, artists, and researchers will also benefit from a bird's-eye view of the public art experience and online popularity. Finally, we recognize that this is the first study of the aesthetic experience of the Arc de Triomphe Wrapped and unwrapped on Instagram and Twitter, as—to the best of our knowledge—there has been no previous work on this topic.

## 2. Related work

### *2.1. The Concept of Aesthetic Experience*

Viewing and encountering art is a two-way street [41]. Several authors, such as Brighouse [42] and Winston and Cupchik [43], have performed preliminary work on this issue. In their studies, they distinguished between passive and active art appreciation by art experts and non-experts. Both studies focused exclusively on spectators' knowledge, neglecting spatial factors and artworks' features. Stendhal Syndrome is one of the most important examples of the impact of art on an individual's emotional state [44,45]. It is a short-term exceptional combination of psychological and somatic symptoms that have been observed during visits to art galleries or travel to cities with stunning architecture, such as Paris. Consequently, it is also known as "city syndrome" [46,47]. Psychiatrist Magherini identified three types of "patients" who suffered from the syndrome [48]; "disorders of thought" (alteration in the perception of sounds and colors, feelings of persecution or guilt, and anxiety), "disorders of affect" (depressive anxiety, feelings of inferiority and inadequacy, precariousness or feelings of superiority, such as euphoric exaltation, omnipotent thoughts, or the absence of criticism of their reality) and finally "panic attacks" (chest pain, sweating, dizziness, tachycardia or digestive discomfort).

Based on the literature, aesthetic experience can include both positive emotions such as pleasure, pride, and surprise, and negative emotions such as anger, contempt, and even disgust [49]. According to Cupchik and Winston [50], and Boccia et al. [51], "Aesthetic experience require that a deliberate shift takes place, from automatic visuo-perceptual processing to an aesthetic state of mind". Several authors have also argued, the "individual experiences outstanding emotions, also feels a unique contact and fluency with the artwork" [52,53]. Pelowski [54] has also proposed a remarkable approach to aesthetic emotions. He proposed that tears are the ultimate physical indicator of emotional responses to art. The findings revealed a positive correlation between the sense of "feeling like crying" and other strong emotions, which can be an important indicator of art experience.

Assumptions by Leder et al. [55] seem to be well-founded in their theoretical model of aesthetic appreciation and aesthetic judgment. In a nutshell, the aesthetic experience can be divided into five stages: "perception", "explicit classification", "implicit classification", "cognitive mastering", and "evaluation". It is based on key visual art elements such as colors [56], contrasts [57], symmetry [58], and complexity [59–61]. Aesthetic perception is strongly influenced by the nature of the exhibits or space [55], previous art or non-art experiences [62,63], and familiarity with art [64,65]. Furthermore, it depends on the viewer's knowledge, domain-specific expertise, personal taste, and social context [55,56]. Moreover, the intangible aspects of artworks (e.g., style perception, content, and emotions) can influence the outcome of this stage [55,66]. Finally, many art viewers associate and value artworks with their own experiences and emotions [67].

### *2.2. Sentiment Analysis*

Before delving into the meaning of popularity and how art is communicated on social media such as Instagram and Twitter, which were used in this study, some research on the analysis of emotions on these platforms is worth mentioning. There is a substantial body of research on social media sentiment analysis using machine learning methods. Saif and Kiritchenko [68] questioned the need for the classification of emotions into more specific and emotion-related categories (such as joy, sadness, or fear) rather than simply positive, negative, or neutral taxonomy, as is prevalent in most studies. They collected data from Twitter and discovered, using the Best–Worst Scaling (BWS) method, that each tweet related to a pair of emotions rather than a single emotion. Therefore, each tweet contained at least two emotions. Elbagir and Yang [69] suggested an ordinal regression-based Twitter sentiment analysis. They also proposed a new balancing and scoring method for the classification of tweets based on polarity. In order to achieve good results, they used lexicon-based and machine learning algorithms such as Support Vector Regression (81.9%), Decision Trees (91.81%), Random Forest (83.2%), and SoftMax (67.2%). Hassan et al. [70] conducted extensive research on Twitter sentiment analysis by employing altmetrics. The annotated data from five disciplines was used to analyze sentiments using machine learning algorithms, and to select the best model. They relied on two datasets: one in English and one in a total of 23 languages. The Support Vector Machines model had the highest accuracy (80%), followed by Logistic Regression (83%) and Naïve Bayes (80%).

Generally speaking, research has primarily focused on Twitter sentiment analysis, rather than Instagram. Furthermore, the majority of the research on Instagram sentiments is based on image analysis, with little emphasis on text. In their experiments, Illendula and Sheth [71] used images, text, and emojis to classify emotions in a multimodal manner. They hypothesized, using deep learning approaches, that a combination of image, text, and emojis could predict users' sentiment, and they achieved 71.98% accuracy. They also found that the heart emoji was used most frequently to express positive emotions. In a similar vein, Karimvand et al. [72] used a multimodal deep learning approach, including a bi-directional gated recurrent unit (bi-GRU) for textual comments in the Persian language and a two-dimensional convolutional neural network (2CNN) for image analysis. The use of both images and text improved polarity prediction. Furthermore, Naseem et al. [73] used deep and machine learning algorithms such as Naïve Bayes, Support Vector Machines, Decision Trees, Random Forest, Convolutional Neural Networks, BiLSTM, L2, and Adam in their study to determine the degree of moderation required to curtail misinformation in social media.

### *2.3. Spreading Popularity*

It is important to stress that our purpose is to investigate the effect of public installation art on people's attractiveness in the sense of art popularity and emotions. The question of whether art or artists have the potential to be popular has preoccupied experts for some time [74–77], but very little is known about the subject. In a recent study of 90 twentieth-century artists [76], scholars discovered that an artist's social network is the most important factor in the prediction of their success. According to references in twentieth-century literature, artists with a more diverse social network (professional and personal relationships from various disciplines) were statistically more likely to be successful than those with a more reliable network [76]. Before the empirical analysis, it would be appropriate to briefly summarize the concept of popularity, which appears to have no general definition in the literature.

In a major advance, Coie et al. [78] discovered that popularity can be divided into four sociometrical dimensions: acceptance, rejection, (social) preference, and (social) impact. Acceptance is the sum of the "most liked" proposals received by a person during a social group experiment. The number of "liked least" proposals is the number of rejections. Preference is the acceptance score, less the rejection score, and Impact is the sum of the acceptance and rejection scores. An essential question was answered by Kang, Chen, and

Kang [79] in their study on how the interaction between artists and followers affects the popularity of each artwork, in order to understand the online context. Similarly, it also questioned how influential the popularity of the most-liked artworks is on the artists' creative process. According to the data, these exchanges had a positive influence on likes and comments. The most popular artworks are influenced by the artists' personal experiences and relationships with followers, but not the creation process. Let us have a look at how the above theoretical framework relates to the public art experience.

### *2.4. Public Art on Air*

It is generally agreed today that monuments are a major draw for locals and tourists from all over the world, and that they arouse various psychological responses [80,81]. We can discover many well-known sights and landmarks by conducting a simple geographical search on social media. Nowadays, Instagram is the most popular canvas for influencers [26] in the promotion of art, among other things. Moreover, "Instagrammism" is defined by Lev Manovich as a mix of media form and content, sometimes with the same style, attitude, and color tones. The purpose of these images is to evoke positive emotions [9]. Stylianou-Lambert [82] emphasized the reasons for photographing museum art. She concluded that the primary reason for taking photographs in an art museum is to preserve the aesthetic experience. Other reasons are emotional fulfillment, enlightenment, and leisure. As a consequence, users look at these posts and consider paying a visit. They frequently use related hashtags [83] and geotags in their posts in order to express their emotions and increase their profile engagement. Furthermore, they photograph public works of art, archeological sites, and monuments for the same purposes.

Based on the literature, we focus on public art and its impact on public space and society. More recent evidence from Cudny and Appelblad [84] explains comprehensively the role of monuments in urban public space. They found that monuments were a major part of public art in cities. According to their literature review, monuments have different functions, such as artistic [85], symbolic [86], commemorative [87,88], political [89], social [85], religious [90], marketing [91] and mixed functions. Yi-Fu Tuan [92] defines "the monument as a symbol, relates to thinking, a visible landmark, a useful sign of orientation which relates to both behavior and action". Monuments have long been regarded as an important component of public art by scholars. Many attempts have been made [93,94] to demonstrate that "public art contributes to social development by determining civic identity, combating social exclusion, and supporting educational value". Massey [95] defines "urban space as the construction of social relations rather than space as an absolute and independent dimension".

For the reasons stated above, we decided to focus on the Arc de Triomphe monument of Paris city in this study. When we searched the name "Paris" on social media, we found many posts that include not only the Eiffel Tower but also the Arc de Triomphe. This is a stimulus for influencers, tourists, or locals to display the French majesty. The Arc de Triomphe is one of the legendary historic monuments in Paris, located in the center of Place Charles de Gaulle as a focal point because it connects twelve avenues, forming a star [96,97]. From 18 September to 3 October 2021, a very impressive project was realized in collaboration with the Centre des Monuments Nationaux and the City of Paris. Christo and Jean-Claude, two renowned artists who have created numerous public art installations, dreamed of wrapping the Arch of Triumph in 1961 [98]. The dream was realized last year with no public funds, and was completed by Christo's team after his death [99]; thus, 25,000 square meters of silvery-blue recyclable polypropylene fabric and 3000 m of red rope were used to wrap the Arc de Triomphe. The project captivated the audience's curiosity, and it was widely shared on social media. This will be investigated in the following section.

## 3. Methodology

This section presents our methodology in detail for the machine learning task in order to achieve our research objectives.

Using Instagram and Twitter data, we compared the above-mentioned criteria to the popularity of Unwrapped and Wrapped installation posts. From a wider viewpoint, Hruska and Maresova [100] observed that the user bases of these two social media platforms differ. We chose them because their users have different demographic features such as age, gender, income, and educational background, such that we could obtain a more representative data set. In order to investigate our aim, we first carried out an exhaustive search, and made a list of Instagram and Twitter hashtags that deal with the Arc de Triomphe. Secondly, we searched for photographs of the Arc de Triomphe that appeared wrapped and unwrapped in those multiple hashtags. We selected all of the captions along with their metadata in the Python programming language.

We chose the total number of likes, comments, shares, text sentiment, and so on as the indicators that reflect the most important aspects of Instagram and Twitter engagement. We hoped to accomplish this by quantifying user interactions that may be elicited by public art attractiveness as an effect of their emotional experience. We also gathered all of the posts in order to predict which sentiment (unwrapped or wrapped installation) was the most common. In order to analyze our research questions (RQs) as they are defined primarily, social media APIs and machine learning algorithms were used in this study. Most of the process was also carried out using the Python programming language. The remainder of the methodology is as follows.

### *3.1. Data Collection*

The Instaloader and Twarc APIs were used to collect data. The Instaloader module is a Python package with many features for the scraping of Instagram data via a command line interface. It can download posts from public or private accounts, stories, IGTV, comments on posts, and profile information such as biographic information and story highlights [101]. Similarly, Twarc is a command-line tool and Python package for the fetching of Twitter data such as likes, tweets, replies, followers, followings, text for sentiment analysis, geotags, and other public metrics of tweets [102].

We collected $N = 7078$ entire posts from the most popular Instagram hashtags (such as #arcdetriomphewrapped, #arcdetriompheempaqueté, #arcdetriomphedelétoile, #christoandjeanneclaude, and #arcdetriompheparis) related to our topic using Python's Instaloader package version 4.9. Using the resumable iterations functions in our Python code, we specified the hashtag and set the date on which the data were collected. Because Instagram limits data downloads per day, we have already downloaded the maximum number of posts that Instagram allows us to achieve. We did the same in order to download data before and after wrapping by changing hashtags and dates each time. The data extracted included image files, as well as the text that accompanied each post. We only kept the textual JSON files from this dataset. We also collected $N = 3776$ entire posts from the most related Twitter hashtags (such as #arcdetriomphe, #arcdetriomphewrapped, #christoandjeanneclaude) using Python's Twarc package. Unlike Instaloader, we could define specific keywords more easily in Twarc Python code by combining hashtags, names, dates, language of tweets, and locations using boolean operators, for instance "query" = "arcdetriomphewrapped OR (Christo and Jeanne-Claude) has:images lang:en -is:retweet". With this type of query, we fetched tweets that were accompanied by images of the Arc de Triomphe before and after wrapping, excluding tweets and their retweets that only contained text without images. The posts were downloaded in JSON format by the Instaloader and Twarc [102], and thus were converted to CSV using Python modules. We created two datasets for unwrapped installation posts and two datasets for wrapped installation posts.

### *3.2. Pre-Processing and Transformation*

The CSV data were a table with seven columns: comments, likes, has more comments, media count, saved to collection, photo-content, and text for Instagram datasets before and after wrapping. For Twitter, the following columns were also stored in CSV format: likes, replies, retweets, followers, followings, tweet count, and text. These data were pre-

processed with the OpenRefine software: a powerful, freely available tool for working with messy data, including cleaning, data, and format transformation privately. It can handle spreadsheets or other file formats such as CSV [103]. We imported the CSV datasets mentioned above as input files, and exported a processed CSV file each time. In compliance with the GDPR privacy law regulation, usernames and IDs were removed from all of the datasets in advance. HTML links, tags, and special characters (@, #, &, %, ", +) were also removed. Spelling errors (for example, "I looooovve Paaarisssss" to "I love Paris") were replaced, and missing values were handled in the OpenRefine environment. Because most algorithms deal with numerical data, the above CSV tables were also transformed from categorical to numerical values in Python using the Column Transformation function and the One-hot encoding from the SciKit-Learn library [104]. The features that were transformed finally from categorical to numerical values were: has more comments, media count, saved to collection, and photo-content. The other attributes were already in numerical form.

### *3.3. Sentiment Classification*

We also used sentiment analysis to detect core emotions in the textual data using the automated SEANCE (Sentiment Analysis and Cognition Engine) [105]. The SEANCE is a freely accessible tool for the conversion of plain text files to comma-separated value (CSV) files. It also allows users to select lexicons for sentiment analysis. The VADER lexicon was chosen because it is well-suited to the assessment of the positive, negative, or neutral sentiments of short texts such as those appearing on Twitter or Instagram [106]. This lexicon can also recognize emojis.

Surprisingly, VADER detected positive emotions in the majority of our data. Negative emotions made up a small percentage of our data (around 10 in $N$ = 10,854 of the total samples); as such, we did not include them in order to avoid an outsized imbalance in the data. Nonetheless, we took a fairly broad approach. We tried a different approach because the VADER lexicon's classification of emotions as positive, negative, or neutral did not correspond to our research objectives. Hence, for the classification task, we decided to use a set of positive emotions such as triumph, attraction, and surprise from a large set of emotions [107,108] in all of the datasets. We did not select these emotions at random. They were a taxonomy of emotions related to the object's properties or events [109]. We thought that these emotions fit the goals of our study as a monument and installation artwork with specific properties, as well as a social event. Furthermore, we accomplished this task using the OpenRefine tool [103] by adding another column called "sentiment" to our dataset and annotating it based on the text content. More precisely, by filtering the text content of the Instagram posts and tweets with specific keywords (e.g., love, hate, wow, I like it, feel, beautiful, disgusting, etc.) or emojis, we assigned each sample to the appropriate sentiment category based on the text content. The next step was to employ machine learning methods.

## 4. Implementation and Results

The classification task's purpose was to correlate different features of the research questions (RQ1, RQ2, RQ3, and RQ4) to the sentiment variable. The aim was to understand how an installation could elicit emotions that may influence an artwork's popularity and attractiveness. We gathered $N$ = 7078 Instagram posts and $N$ = 3776 Twitter posts, respectively, from the most popular Instagram and Twitter and hashtags related to our topic, such as #arcdetriomphewrapped, #arcdetriomphe, #arcdetriomphecristo, #arcdetriompheempaqueté, and #arcdetriomphedelétoile.

In addition, we set a time margin in the Python module for the extraction of the data from 18 September 2021 to 3 October 2021 during the exhibition as wrapped, and from 18 June to 3 July 2021 as unwrapped. We downloaded all of the related posts we encountered on both social media platforms and created four datasets about the Arc de Triomphe: two for Instagram and two for Twitter Wrapped and unwrapped.

### *4.1. Data Exploration*

We began by investigating our Instagram data in order to determine how it was distributed. The first two datasets included values such as the likes count, comments, media count (the feed or a carousel container which includes two or more captions), has more comments (if it was the most popular post in each profile), saved to collection (if the viewer saved the post), photograph content (if the caption depicted the single monument or the monument and people), and sentiment feature.

As we noticed, the second Instagram dataset had a higher total number of user interactions such as likes and comments than the first Instagram dataset. The majority of users shared captions of the monument as wrapped rather than unwrapped, ranging from a single post to ten posts as a carousel album. According to the feature's media count mean value, the total number of photographs of the Arc de Triomphe Wrapped posted by users increased (Table 1).

**Table 1.** The statistical description of the Arc de Triomphe Instagram datasets.

| **Arc de Triomphe Unwrapped, Instagram Dataset 1 (*N* = 1058)** | | | | |
|---|---|---|---|---|
| **Features** | **Minimum** | **Maximum** | **Mean** | **Std.Deviation** |
| Likes | 1.00 | 7202.00 | 225.95 | 772.66 |
| Comments | 1.00 | 111.00 | 8.20 | 18.27 |
| Media count | 1.00 | 10.00 | 1.99 | 2.18 |
| **Arc de Triomphe Wrapped, Instagram Dataset 2 (*N* = 6020)** | | | | |
| **Features** | **Minimum** | **Maximum** | **Mean** | **Std.Deviation** |
| Likes | 1.00 | 90,992.00 | 2037.08 | 7455.34 |
| Comments | 0.00 | 905.00 | 25.61 | 64.78 |
| Media count | 1.00 | 10.00 | 2.72 | 2.82 |

However, in terms of popularity, Arc de Triomphe Wrapped posts were the most popular among all of the other posts in user accounts at the time the data were collected. It is also important to keep in mind that it is saved to users' Instagram collections as wrapped rather than unwrapped, indicating that users are actively involved and interested in engaging with art and aesthetics. Another analysis that supports our hypothesis is the fact that more spectators were photographed with the "Arc de Triomphe Wrapped" than ever before. Some remained in front of the monument or photographed only the monument (Table 2), whereas others unexpectedly touched or embraced the art installation's material.

**Table 2.** Description of the binary values of the Instagram datasets.

| **Arc de Triomphe Unwrapped, Instagram Dataset 1 (*N* = 1058)** | | | | |
|---|---|---|---|---|
| **Features** | **TRUE** | **%** | **FALSE** | **%** |
| Has more comments | 413 | 0.39 | 645 | 0.61 |
| Saved to collection | 385 | 0.36 | 673 | 0.64 |
| Photo-content | 859 | 0.81 | 199 | 0.19 |
| **Arc de Triomphe Wrapped, Instagram Dataset 2 (*N* = 6020)** | | | | |
| **Features** | **TRUE** | **%** | **FALSE** | **%** |
| Has more comments | 3503 | 0.58 | 2517 | 0.42 |
| Saved to collection | 3547 | 0.59 | 2473 | 0.41 |
| Photo-content | 3212 | 0.53 | 2808 | 0.47 |

We continued by exploring the next two Twitter datasets in order to ascertain how they were distributed. According to Table 3 below, the datasets included values such as the likes count, replies, retweets, followers, following, tweet count (the total number of tweets from all users), and the text sentiment feature, which will be analyzed in the next section.

**Table 3.** The statistical description of the Arc de Triomphe Twitter datasets.

| **Arc de Triomphe Unwrapped, Twitter Dataset 1 (*N* = 1868)** | | | | |
|---|---|---|---|---|
| **Features** | **Minimum** | **Maximum** | **Mean** | **Std.Deviation** |
| Likes | 1.00 | 1,1261.00 | 121.04 | 678.92 |
| Replies | 1.00 | 364.00 | 6.82 | 21.22 |
| Retweets | 1.00 | 8888.00 | 61.04 | 344.36 |
| Followers | 1.00 | 25,824,210.00 | 45,058.89 | 640,936.30 |
| Following | 1.00 | 94,615.00 | 2178.13 | 6020.01 |
| Tweet count | 4.00 | 1,114,423.30 | 16,544.69 | 59,584.77 |
| **Arc de Triomphe Wrapped, Twitter Dataset 2 (*N* = 1908)** | | | | |
| **Features** | **Minimum** | **Maximum** | **Mean** | **Std.Deviation** |
| Likes | 0.00 | 2,587,126.00 | 4833.00 | 63,761.42 |
| Replies | 1.00 | 3973.00 | 33.44 | 201.14 |
| Retweets | 0.00 | 2,010,119.00 | 3942.56 | 50319.84 |
| Followers | 2.00 | 50,786,600.00 | 46,954.20 | 1,185,350.00 |
| Following | 0.00 | 38,801.00 | 1406.94 | 2539.91 |
| Tweet count | 2.00 | 1,383,877.00 | 25,547.89 | 74,661.78 |

As shown below, Twitter has few metadata options and is more limited to the basic users' reactions than Instagram. Nonetheless, even in that case, user interactions such as likes, replies, and retweets were greater in the second Twitter dataset of "Arc de Triomphe Wrapped" than in the first Twitter dataset. The total amount of followers and followings differed slightly. Even so, this had an impact on the popularity of the posts. Regarding the tweet count, it should be noted that it was a significant component of popularity because it demonstrated that the users are very active and impressed by the public installation art. The following section examines the sentiment feature in detail. For that reason, we decided not to include them in the tables above.

### *4.2. Classification Task and Findings*

Next, we used six of the most prominent supervised learning algorithms from SciKit-Learn Library 97 for spot-checking in all of the RQs. Then, we selected the ones that suited our data well. These algorithms are Linear Regression (LR), Linear Discriminant Analysis (LDA), K-Nearest Neighbors (KNN), Classification and Regression Trees (CART), Naïve Bayes (NB), and Support Vector Machines (SVM). We used our data to test all of the algorithms in order to see how well they worked with this type of data. Two of them outperformed the others; the Classification and Regression Trees (CART) and Support Vector Machines (SVM) algorithms worked better for both datasets.

- **RQ1:** What sentiments inspire people to share monuments on social media?

Before moving on to our examination, we should point out that this research question is common to all datasets of the Arc de Triomphe, both unwrapped and wrapped. According to the sentiment analysis and annotation processing, three emotions emerged that stimulated users to comment and share posts of the Arc de Triomphe monument before and after the installation art. These emotions were triumph, attraction, and surprise [107,108] for all of the datasets with *N* samples (see Table 4) per dataset. For both Unwrapped datasets, the attraction value is the class with the largest number of samples. Contrary to both Wrapped datasets, the surprise value was the class with the largest number of samples. The sentiment of surprise getting over the other classes indicates that the viewers were astonished by the Arc de Triomphe Wrapped Installation art and wanted to share their aesthetic experience on social media. The aim was to classify the four features related to sentiment.

**Table 4.** The frequency of three sentiments in the Instagram and Twitter datasets.

| Arc de Triomphe Instagram Datasets | | | | | Arc de Triomphe Twitter Datasets | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sentiment** | ***N*** | **Frequency Unwrapped** | ***N*** | **Frequency Wrapped** | **Setniment** | ***N*** | **Frequency Wrapped** | ***N*** | **Frequency Wrapped** |
| Triumph | 1058 | 254 | 6020 | 927 | Triumph | 1868 | 432 | 1908 | 351 |
| Attraction | 1058 | 514 | 6020 | 2022 | Attraction | 1868 | 968 | 1908 | 436 |
| Surprise | 1058 | 290 | 6020 | 3071 | Surprise | 1868 | 468 | 1908 | 1121 |
| Valid *N* | 1058 | | 6020 | | Valid *N* | 1868 | | 1908 | |

Moreover, we used the SMOTE (Synthetic Minority Over-sampling Technique) method from Imbalanced Learn Library [110], which is fully compatible with SciKit-Learn API [104] for imbalanced datasets [111], as all of the datasets were slightly imbalanced. The SMOTE technique [111–113] oversamples all minority classes by default to have the same number of examples as the majority class. In our case, the class attraction has the most samples with $N = 514$ and $N = 968$ correspondingly for the Unwrapped datasets, and the class surprise had $N = 3071$ and $N = 1121$ for the Wrapped datasets. Consequently, SMOTE oversampled all of the classes in order to obtain an approximately equal number of samples. Thereby, we can improve the algorithm performance and obtain better results. In this case, the class attraction had the most samples with $N = 514$ and $N = 968$ for the unwrapped and wrapped datasets, respectively, and the class surprise had $N = 3071$ and $N = 1121$ likewise (Table 4). Thereby, concerning the next research questions, we improved the algorithm performance and obtained better results.

- **RQ2:** What is the relationship between users' reactions and sentiment regarding the Arc de Triomphe monument?

In order to evaluate the relationship between user interactions such as likes, comments, shares, followings, and so on, we experimented on our datasets by using the two efficient supervised learning algorithms, CART [114] and SVM [115], which emerged from spot-checking. By correlating the users' reactions to each post of the Arc de Triomphe unwrapped with the text sentiment, we were able to predict how a renowned monument could elicit emotions that were then expressed on social media. We associated all of the features with each other, and classified them predicated on sentiment. For instance, we associated likes and comments or replies and retweets with the sentiment feature, or each one separately with the sentiment. According to the percentages below, the triumph sentiment outnumbered the surprise and attraction sentiments in the Instagram Dataset, but surprise outnumbered attraction and triumph sentiments in the Twitter Dataset. That correlation, as illustrated in Table 5, bears out our assumption about how a historical and majestic monument could motivate people to share their emotions through the posts.

In particular, the algorithms approached our data successfully in correlations in up to 93% of cases, as depicted in Table 5. The standard deviation of the two algorithms was as follows: CART (0.05%) and SVM (0.04%) for the Instagram dataset, and CART (0.02%) and SVM (0.01%) for the Twitter dataset. In both previous scenarios, we correlated all of the features. Regarding the Instagram dataset, we discovered that the number of likes, comments, and media count (feed or carousel container) were all directly linked to the sentiment feature, while the other three characteristics—more comments, saved to collection, and content—were much less so, up to 50%. We did the same for the Twitter dataset. Furthermore, we used the SMOTE technique [111–113] because the test yielded slightly lower percentages than expected. We correlated all of the features with each other. We discovered that the number of likes, replies, and retweets is proportional to the sentiment, whereas the number of tweets per user and the number of followers and followings were less related to the sentiment. In order to avoid this, we used a standard set of metrics for both datasets. It was critical to select the appropriate metric for model evaluation. For imbalanced classification datasets, accuracy as a performance metric is occasionally unsuitable. In order to avoid this, we used a standard set of metrics for both datasets.

The classification report includes a breakdown of each class (attraction, triumph, surprise) by precision, recall, f1-score, and support metrics, illustrating slightly better results [116]. Therefore, based on these positive outcomes, we indicated that our classification model was accurate to some extent. Moreover, we set a 10-fold cross-validation and 25% validation test in both datasets. By using this resampling procedure, each sample of the training dataset was used to train the model k-10 times. As a consequence, all of the samples were examined in order to estimate the model's suitability. The model succeeded in correctly classifying the new instances of monument posts respectively, to some extent.

**Table 5.** Outcome evaluation by the classification report.

| Instagram Dataset of Arc de Triomphe Unwrapped 1 | | | | |
|---|---|---|---|---|
| **Sentiment** | **Precision** | **Recall** | **f1-score** | **Support** |
| Attraction | 0.81 | 0.71 | 0.76 | 96 |
| Surprise | 0.76 | 0.86 | 0.80 | 77 |
| Triupmh | 0.80 | 0.82 | 0.81 | 90 |
| accuracy | | | 0.79 | 263 |
| macro avg | 0.79 | 0.80 | 0.79 | 263 |
| weighted avg | 0.79 | 0.79 | 0.79 | 263 |
| **Twitter Dataset of Arc de Triomphe Unwrapped 2** | | | | |
| **Sentiment** | **Precision** | **Recall** | **f1-score** | **Support** |
| Attraction | 0.50 | 0.93 | 0.65 | 119 |
| Surprise | 0.88 | 0.58 | 0.70 | 130 |
| Triupmh | 0.81 | 0.41 | 0.54 | 123 |
| accuracy | | | 0.64 | 372 |
| macro avg | 0.73 | 0.64 | 0.63 | 372 |
| weighted avg | 0.73 | 0.64 | 0.63 | 372 |

Note: Correlation between user's reactions and sentiment of Arc de Triomphe Unwrapped.

- **RQ3**: What is the relationship between users' reactions and sentiment regarding the "Arc de Triomphe Wrapped" Installation art?

In order to assess this correlation, we conducted the same testing on Instagram and Twitter datasets of the Arc de Triomphe Wrapped, by using the two well-behaved algorithms, as beforehand: CART [114] and SVM [115]. The idea was to compare all of the features with the sentiment feature in order to predict how a public installation artwork like Arc de Triomphe Wrapped could elicit emotions that were then expressed online. That correlation, as shown in Table 6, verified our hypothesis about how the installation art aesthetic experience influences the monument's attractiveness. We associated likes and comments with the sentiment feature, likes and nwords (the total number of words) with the sentiment, or each independently with the sentiment. According to the percentages below, the triumph sentiment outnumbered surprise and attraction sentiments in the Instagram dataset, but surprise outnumbered attraction and triumph sentiments in the Twitter dataset. The fact that the total percentage in the second Instagram and Twitter datasets is slightly higher indicated that viewers wanted to share their aesthetic experiences with the Arc de Triomphe Wrapped installation art on social media platforms.

We assumed that when viewers reacted positively to the monument, they would be surprised when they eventually saw the monument as a wrapped installation artwork. Bringing a more philosophical approach to this issue, Montesquieu—in his essay titled "Essai sur le gout" [117]—states that the human soul tends to prefer simplicity and symmetry in order to perceive things, and variety in order to enjoy them. This is what actually happened with the Arc de Triomphe. Viewers appreciated the monument's simplicity and symmetry [58], but they really enjoyed its variety as an installation artwork. We associated all of the features with each other. We saw a positive correlation between the total number of Instagram likes, comments, media count, and sentiment, whereas features like more comments, saved to collection and photo-content were less associated with the sentiment.

Moreover, we did the same procedure for the Twitter dataset. We discovered that the number of likes, replies, and retweets was proportional to the emotion, while the number of tweets per user and the number of followers and followings were much less related to the sentiment value. Furthermore, in that case, we implemented the same performance metrics for all of the correlations. For the Instagram dataset, the results were relatively better than the first, and significantly higher for the Twitter dataset.

**Table 6.** Outcome evaluation by the classification report.

| Instagram Dataset of Arc de Triomphe Wrapped 1 | | | | |
|---|---|---|---|---|
| **Sentiment** | **Precision** | **Recall** | **f1-score** | **Support** |
| Attraction | 0.76 | 0.74 | 0.75 | 200 |
| Surprise | 0.78 | 0.82 | 0.80 | 197 |
| Triupmh | 0.84 | 0.81 | 0.83 | 203 |
| accuracy | | | 0.79 | 600 |
| macro avg | 0.79 | 0.79 | 0.79 | 600 |
| weighted avg | 0.79 | 0.79 | 0.79 | 600 |
| **Twitter Dataset of Arc de Triomphe Wrapped 2** | | | | |
| **Sentiment** | **Precision** | **Recall** | **f1-score** | **Support** |
| Attraction | 0.80 | 0.89 | 0.84 | 119 |
| Surprise | 0.93 | 0.98 | 0.95 | 123 |
| Triupmh | 0.91 | 0.75 | 0.82 | 118 |
| accuracy | | | 0.88 | 360 |
| macro avg | 0.88 | 0.87 | 0.87 | 360 |
| weighted avg | 0.88 | 0.88 | 0.87 | 360 |

Note: The correlation between users' reactions and sentiment regarding Arc de Triomphe Wrapped.

Likewise, for the foregoing correlations, the algorithms approached our data efficiently (see Table 6) at a rate of up to 84% for the Instagram dataset, in which triumph appeared to be the higher class. We also used the SMOTE technique [111–113] in that case. For the Twitter dataset, the algorithms approached the data at a rate of up to 98%, showing that surprise appeared to be the highest class. The standard deviation was as follows: CART (0.01%) and SVM (0.01%) for the Instagram dataset, and CART (0.02%) and SVM (0.03%) for the Twitter dataset. We again set a 10-fold cross-validation and 25% validation test in both datasets. Using this resampling method, each sample of the training dataset was used to train the model k-10 times. As an effect, all of the samples were examined in order to estimate the model's suitability. According to these findings, we concluded that our classification model was quite accurate. The model was successful in correctly classifying new instances of Arc de Triomphe Wrapped posts in both cases. This revealed that the viewers were surprised by the "Arc de Triomphe Wrapped" installation art, and that they shared their unique aesthetic experience online.

- **RQ4:** In which of the two cases were the spectators photographed with the monument more frequently? Does this affect popularity?

These experiments were carried out in order to investigate the impact of the public art installation of the "Arc de Triomphe Wrapped" in Paris, France on human emotions, and how this aesthetic experience increases the popularity of this public artwork.

As follows in Figure 1, shown below, the photo content feature has two values: monument, or monument and people. One is for images of the monument by itself, and the other is for images of the monument with people interacting with it in various ways. According to our findings, people were photographed more frequently alongside the monument as an artistic installation than in previous times.

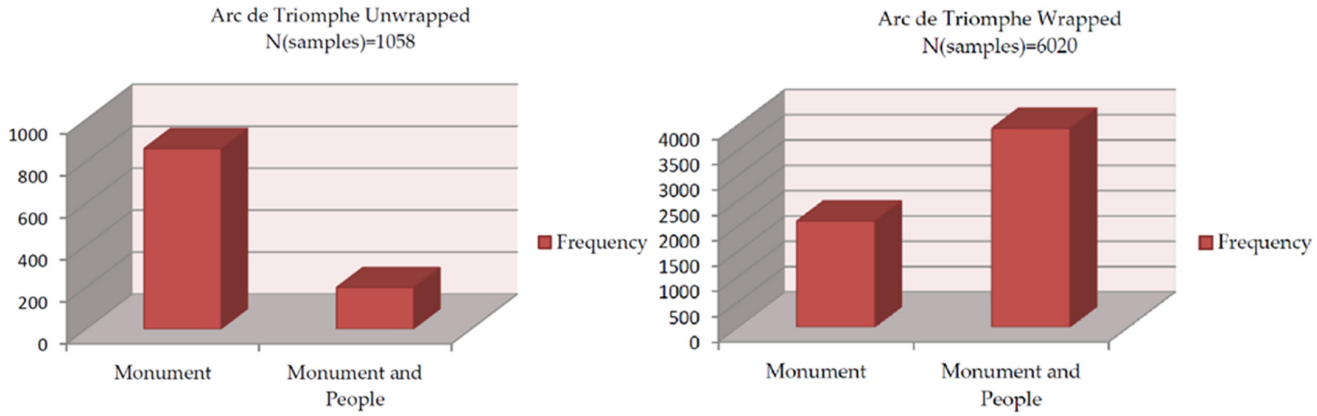



**Figure 1.** Graphic representation of the Instagram datasets. (**Left**) The frequency of classes in the Arc de Triomphe Unwrapped dataset. (**Right**): The graph indicates the frequency of photographs in the Arc de Triomphe Wrapped dataset.

More precisely, in the Arc de Triomphe unwrapped dataset, $N = 860$ instances from a set of samples $N = 1058$ included photographs of the monument by itself, while the remaining $N = 198$ concerned photographs of people and the monument together. Although, in the second dataset, from a sample size of $N = 6020$, the $N = 2043$ instances were photographs of the monument by itself, while $N = 3977$ were photographs of people and the monument together, absolutely at a much higher percentage than in the first dataset. We accept that the sample size in the first dataset is smaller, but it gave us a bird's-eye view of how society interacts with the monument, the emotions they felt, and their social media photography practices or narratives. The overall measurements indicated that a public installation as a form of art may elicit positive emotions in the audience. Some of them posted original photos by touching or embracing the subject material. The fact that the sentiment analysis displayed only positive emotions, as well as the fact that more Instagram and Twitter posts were shared during the public exhibition, firmly supports our hypothesis regarding the influence of art popularity.

Recent developments in Instagram engagement have also glanced at the popularity of art on Instagram, not even from an emotion-based perspective, as we do in this paper. Kang, Chen, and Kang [79], for instance, examined the most-liked artworks, as well as the relationship between Instagram interactions and the creative artistic process. It is interesting to note that we didn't find any previous work on the Instagram sharing of public installation art. Pelowski et al. [118] assessed the effects of two installation artworks by Olafur Eliasson. They used eye-tracking to evaluate the aesthetic experience. Their research was held entirely in a museum context, with no reference to social media. Furthermore, Pelowski et al. [119] investigated whether viewers can feel the same emotional responses as the creators of installation artworks. It was discovered that they can, to a large extent. Another point of view was the interactive installation art studied by Morreale and Angeli, such as the Music Room [120]. Positive emotions were found to be more prevalent than negative. Gartus, Klemer, and Leder [121] investigated how the setting influences the perception of art in contemporary works of art and graffiti. According to the findings, works inside the museum were more frequently observed than those on the street. Finally, we would like to point out that no corresponding study for artistic installations in monuments was discovered.

## 5. Limitations

It was plausible that some limitations may have influenced the results obtained in this paper. To the best of our knowledge, this was the first study to deal with Instagram and Twitter data in the context of the Arc de Triomphe Wrapped installation artwork by Christo and Jeanne-Claude [99]. We used a normal sample of data before and after the "wrapping" to explore this topic, but we planned to fully investigate it in our future papers.

We preferred Instagram and Twitter posts over other social media applications because they are the most popular networks where art is shared widely and very fast.

The analysis was not user-oriented, but rather reaction-oriented. Biographic information like gender, age, country of origin, level of education, and interests were not examined. Furthermore, we did not examine any artistic attributes of the installation or peripheral factors of the space around the Arc de Triomphe. Aside from that, we obtained satisfactory results that supported our idea. It is critical to highlight the technical difficulties we encountered at this point. Taken as a whole, the most challenging part of the process was the data collection across all of the relevant Instagram hashtags with the Instaloader library. Due to the changes to their API and a severe rate limit, the data gathering took a very long time to implement. Twitter, on the other hand, allowed us to collect large amounts of data in a matter of seconds. We had to create multiple Instagram accounts in order to download the data because Instagram kept blocking us.

## 6. Conclusions and Further Research

From the outcome of our investigation, it is possible to conclude that besides the limitations mentioned above, these findings offer some conclusions on the issue, which will be examined further in future studies. We conducted an extensive analysis of different datasets in order to respond to our research questions on how a public installation artwork like the "Arc de Triomphe Wrapped" in Paris, France could elicit emotions that influenced popularity, out of four supervised machine learning tasks. The excessive use of social networking in all aspects of living has also reshaped the way we enjoy arts and culture. Thus, we chose the Arc de Triomphe Wrapped, because it was a new, eye-catching installation that therefore went viral.

Our findings revealed that people were fascinated by the poetic installation of Arc de Triomphe Wrapped, and that they took more photographs of the monument along with the viewers. The interaction with the artwork is also noteworthy. As observed from the photographs, some viewers touched the fabric, while others simply leaned on it, while others stood in front of it for capture, and still others hugged the material in order to express their emotions. According to the results of four classification experiments, we discovered that the sentiments of surprise and triumph were the most prevalent on both social media platforms. There was a considerable increase in the total number of likes, comments, and other investigated features too.

In this study, we have provided further evidence of public art aesthetic experience, which has been greatly influenced by the social media era. Daily, a great percentage of influencers are photographed in various photogenic cities and countries in order to promote a product or services. For example, the travel and fashion influencers we see regularly promote hotels, restaurants, clothes, and other commodities [26]. As Lev Manovich [9] points out, this is what the Instagrammism notion entails.

We will also made an effort, in the future, to gain insight into the art popularity topic by attempting to ask more sophisticated research questions, collecting more complex data, and combining factors such as aesthetic experience (emotions, personal traits), artwork attributes (type, colors, content) or space aspects (lighting, space design, display practices), and social media user reactions. We hope that this research will be a beneficial part of social media studies through the prism of public art and popularity. From an academic viewpoint, we suppose that our findings could motivate other scholars for future research in diverse fields such as art curatorship, the management of cultural heritage, marketing and communication, aesthetics, history of art, tourism, and culture analytics.

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