Green Time Not Screen Time

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Abstract

Public parks serve a critical role in promoting physical activity and mental well-being. However, attendance has declined significantly, particularly in the aftermath of the COVID-19 pandemic. In North Carolina, park usage decreased by 56%[9], over this same period screen has time increased 52% [12], suggesting people are shifting from outdoor activities to sedentary indoor activities. This raises concerns about the long-term effects of excessive screen time and reduced outdoor activity on public health. This study seeks to address this issue by examining strategies to enhance park accessibility and appeal, ultimately encouraging physical activity through parks as an alternative to screen time.

We applied sentiment analysis to over 3,000 Google Maps reviews from 16 Charlotte-Mecklenburg parks to identify the factors that most influence park perception and usage. Using techniques such as TF-IDF vectorization, chi-square feature selection, and TextBlob sentiment scoring, we extracted key themes related to safety, cleanliness, amenities, and overall park experience. These insights were then mapped to actionable recommendations based on recurring patterns in public feedback. By translating sentiment data into specific, localized guidance, this study provides a framework that enables policymakers and park officials to make data-driven decisions that improve park infrastructure and promote greater community engagement.

CCS Concepts

• **Information Systems** → *Sentiment Analysis.*

Keywords

Parks, Screen Time, Green Space, Activity

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1 Introduction

North Carolina has over 250 thousand acres of public parks and Charlotte-Mecklenburg county alone accounts for 11% of that total green space [2]. Despite this availability, park usage plummeted during the COVID pandemic in 2020. 56% of respondents to a North Carolina survey reported reducing or stopping their park visits during the COVID-19 pandemic[9]. During this same time period, geo-tracked data, using cell-phone locations showed similar results, indicating a 15% drop in park visits in North Carolina [9]. Trends like these raise concerns regarding the decline in outdoor activity, which is crucial for one's physical and mental well-being [9].

This lack of park usage has led to a shift in the ways children spend their free time. Rather than engaging in outdoor physical activities, children are instead spending more time in front of their screens[12].The resulting lack of face to face interaction and physical activity in children leads to the potential for negative developmental social and health outcomes, such as obesity, depression, and anxiety. A study investigating obesity rates before and after COVID-19 in children and adults revealed a significant increase in obesity, from 11% in men and 15% in women before COVID-19, to 25.3% in men and 42.4% in women after COVID-19 [15]. Furthermore, studies have also indicated an increase in mental health issues, with the prevalence of anxiety and depression in children increasing from 11.6% before COVID-19 to 25.2% after COVID-19 [20].

These negative impacts associated with excessive screen time can be mitigated through increase park usage. Parks encourage physical activity, which helps reduce obesity and support immune system development in children [17]. Access to green spaces has also been linked to lower rates of anxiety depression, and offers cognitive benefits for children [19]. The goal of this research is to explore how parks can be made more appealing for families, to help promote healthier alternatives to screen time and encourage greater outdoor engagement.

To achieve this, we will analyze reviews from parks with the goal of determining what park users find positive and negative about their experience to discover how to make parks more appealing to their local communities. This research explores whether sentiment analysis can effectively identify parks strengths and weaknesses

in the Charlotte-Mecklenburg county, in order to help develop strategies for boosting park attendance. Similar sentiment analysis research has been successfully conducted on parks in different parts of the world [3, 5, 7]. The data for this sentiment analysis was collected via the online reviews of Charlotte-Mecklenburg area parks through Google Maps. These reviews provide firsthand insight from people who live in or have visited Mecklenburg-County parks. This research aims to highlight the value of public opinion, assisting Mecklenburg County Parks and Recreation Department make data-driven decisions that could enhance park usage. This will subsequently promote healthier lifestyles and increased community engagement. Additionally, understanding both public perceptions of parks and the barriers that prevent their use, can help policymakers and park officials implement strategies to improve park engagement.

2 Background

Parks play a critical role in encouraging outdoor activity and social engagement, yet usage has declined in recent years. In North Carolina, 56% of residents reported reducing or stopping park visits since the COVID-19 pandemic [9]. During this same period, screen time among youth increased by 84 minutes per day—a 52% rise—with the highest increases observed in individuals aged 12 to 18 [12]. Children now average over 245 minutes of screen time daily, far exceeding the American Academy of Pediatrics' recommendation of no more than two hours [11]. Excessive screen time has been linked to a range of negative outcomes, including higher risks of obesity, depression, and anxiety [14]. These trends highlight the growing need for accessible outdoor spaces like parks, which can offer healthier alternatives and support overall community well-being.

2.1 The Risks of Excessive Screen Time

It would be incorrect to say that screen time has no benefit in children. Today's technology driven world requires skills associated with screen usage, such as online lectures and class work. The issue arises when the amount of screen time becomes excessive. A study focused on screen time's effect on child development shows an increase in screen-based technology usage leads to a decreased engagement with nature, negatively impacting mental health. More specifically this study has shown that increased exposure to televisions between six to 18 months is linked with aggressive behaviors [14]. Similar trends are seen across all ages of adolescents as depression and anxiety are leading causes of reduced quality of life among children, which leads to an elevated risk of poor mental health into adulthood [16].

Additionally, excessive screen time has equally negative impacts on one's physical health. A study conducted using electronic databases such as PubMed, Embase, and Scopus revealed that children in the highest categories of screen time were 1.27 times more predisposed to developing obesity [4]. Increasing reliance on screens for entertainment show the need for a healthy alternative, such as parks. Giving children the ability to engage in free play or structured activities can help curb the mental and physical health crisis.

2.2 Health Benefits of Physical Activity and Park Access

To better understand the importance of parks, it is essential to explore the health benefits provided by green spaces. Research consistently shows that engaging in physical activity regularly improves one's strength, motor skills, mental well-being, and immune function while also reducing the risk of chronic diseases [17]. However, despite all these benefits associated with physical activity, many children still fail to meet the recommended 60 minutes of physical activity per day. A survey conducted by the national CDC Youth Risk Behavior showed that only 36% of high school students are meeting this benchmark[11]. This emphasizes the underlying issue of an unhealthy rise in screen time combined with a less than ideal amount of physical activity.

2.3 Factors that Influence Park Attendance

These reasons make it clear that understanding how to get kids to parks is vital. This will be achieved through sentiment analysis of publicly available park reviews. Prior to beginning this analysis, background research was conducted to identify possible factors that may contribute to park attendance. Public safety in parks is an important characteristic influencing the frequency of their use. Crime, especially violent crime, drastically decreases park use. A 2013 survey of Greensboro, North Carolina residents confirmed that people never visited parks in the first place due to crime [13]. This shows that even prior to the COVID-19 pandemic, there were problems in parks deterring visitors.

In addition to the safety aspect, the condition and amenities parks have also play a role in park attendance. Having access to clean, quality parks has been shown to increase activity levels.A study from Victoria, Australia focused on neighborhood parks in which park attendees were observed for one year. One park from this study was renovated in late 2009, while another park of similar acreage was kept the same as a control. The renovated park added the following amenities: a leash-free area for dogs, an all-abilities playground, a 365-m walking track, a barbecue area, and improved landscaping. One year after renovations, researchers observed a 319% increase in total patrons and a 497% increase in children under the age of 18 attending. The control park on the contrary saw a 38% decrease in total patrons and an 80% decrease in children under the age of 18. The activities of attendees was also observed in these 2 parks, specifically walking and vigorous activity. The control park saw a 100% decrease in vigorous activity and 32% decrease in walking. However, the renovated park saw a 567% increase in vigorous activity and 138% increase in walking [18].

2.4 Cognitive Benefits of Nature Exposure

Another reason as to why parks are an ideal place for the development of children is the cognitive benefits that come with being in nature. Studies have shown that exposure to natural environments can significantly enhance one's working memory, selective attention, and processing speed. One study found that children aged 8-15 had enhanced selective attention following a 30-minute walk through forested parks [19]. Another study showed that schools that provided children with outdoor learning experiences had much greater long-term knowledge retention [19]. One last study tested

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the difference between children who had their school recess in green space as opposed to a cement environment, this study concluded that children who had access to the green space for recess had enhanced cognitive functions and greater sense of rejuvenation [1]. These findings emphasize that parks can play a crucial positive role in a child's development as it provides them with a natural environment which promotes not only positive physical development but also positive cognitive development as well.

2.5 Justification for Sentiment Analysis

In order to justify why sentiment analysis on park reviews is used to identify ways to increase park attendance, it is important to recognize why we take this approach. Crucial information can be mined both from social media platforms and online reviews. There is substantial precedent for using sentiment analysis to analyze park reviews, as sentiment analysis has been successfully used to analyze parks in cities such as Dublin, London, Brussels, and Shanghai.[3, 5, 7]. Although these previous studies used sentiment analysis to describe public perception or classify park typologies, they do not focus directly on making policy recommendations based off these insights. Recognizing this gap in the literature, our research aims to build on the prior work by using sentiment analysis to inform actionable policy recommendations. We present a structured framework that converts community feedback into categorized, localized recommendations for park improvements.

3 Methodology

3.1 Dataset Description

The dataset was created via accessing publicly available Google Maps reviews on parks in the Charlotte-Mecklenburg area. From these reviews three columns were created: the user's name, the date of the review, and the user's written review. Reviews that did not contain any written content were omitted from the dataset as they provided no value to the model.

To ensure a non-biased dataset was created, only parks with at least 100 reviews were included. This limit was set in order to make sure the data collected is properly balanced by avoiding parks in which not much user feedback was available. Additionally, both positive and negative reviews were retained. Both provide valuable information for the model and allow for better understanding of public perceptions and possible factors that may influence park attendance.

Given the size and diversity of Charlotte-Mecklenburg County, parks were selected from different geographic areas across the county in order to minimize any biases that may arise from using data from parks in just specific areas. This ensures that the dataset represents a variety of different parks across the County rather than parks concentrated in select locations. Based on these criteria, 16 parks were chosen, resulting in a dataset containing 3,164 unique reviews.

This dataset will serve as the foundation for the sentiment analysis, which aims to identify key factors influencing park attendance. By analyzing user feedback, we hope to gain insights into aspects such as park safety, cleanliness and visitor satisfaction. This will aid in creating an action plan to improve parks in an attempt to increase community engagement. The following image displays where each park is located, relative to the Charlotte-Mecklenburg County.

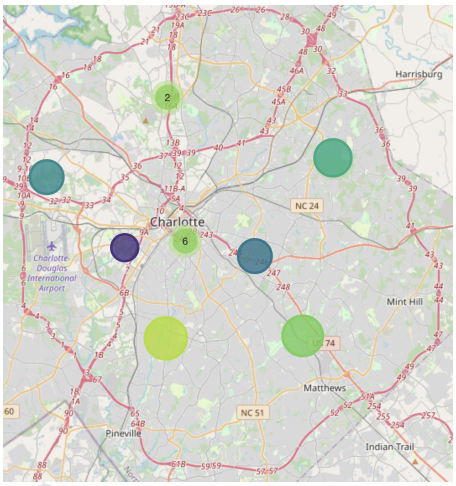

Figure 1: Map Showing Parks: Size of Circle relating to number of reviews

3.2 Preprocessing

The quality of data affects many steps that follow preprocessing, which makes it a critical step when analyzing text. When working with data that has been webscrapped there can be many issues regarding format. The length of reviews specifically caused issues when using the browser extension "Instant Data Scraper". For instance, reviews that were written as multiple paragraphs lead to the extension creating separate entries for each paragraph. Subsequently our dataset was left with a row correctly filled out with park name, user info, date and zip code from that review, but then left the rows beneath to only have the review column filled out where that next paragraph picks up. To fix this, a for loop was created to find rows with null values in park name, user info, date and zip code, then append the review text to the index before. Once the review data was added to the above index, the rows with null values were deleted. Additionally there were many instances of special characters or emojis being used in reviews, our future model would not be able to represent these so they were removed.

We used tokenization to transform our data to a usable format. This is a process of breaking down sentences into individual words called tokens. For example a review might state "This park is amazing", through tokenization this would become "This", "park", "is", "amazing". In addition while this was happening all words were converted to lowercase. After this step we used the library "Textblob" for spell checking commonly misspelled words.

Reviews are often written in complete sentences, this adds many additional words that can be categorized as stop words. These were removed using the NLTK library of common stop words, in addition to many custom words. For example we removed park names from the reviews. Then synonym mapping was added to reduce the amount of unique descriptive words, for example "great", "nice", "awesome", "fantastic", and "excellent" were all changed to "good".

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3.3 Sentiment Analysis Methods

We used Term Frequency-Inverse Document Frequency (TF-IDF) to identify key tokens. This statistical method converts written reviews into numerical values by multiplying a term's frequency in a review by the inverse of its frequency across all the reviews [6]. This highlights terms that are common in one review but rare across the dataset, allowing the model to focus on these terms as they are seen as more meaningful and unique to the specific review.

To refine features, we then used chi-square feature selection, which evaluates the relationship between terms and sentiment categories. This helped identify words most relevant for distinguishing between positive, neutral, and negative reviews.

Sentiment scores were then calculated using Textblob, a Python library that assigns each review a polarity score from -1 to 1. Negative values suggest negative sentiment, positive values suggest positive sentiment, and scores closer to zero indicate neutrality. [10]

3.4 Evaluation and Classification

Finally to further classify the reviews beyond just their sentiment scores, a Support Vector Classifier or SVC was employed to categorize the text by polarity. This turned our text into numeric data on which further analysis could be conducted. With our sentiment scores determined and organized we could begin looking at areas for park improvement such as cleanliness, safety, and amenity.

3.5 From Analysis to Recommendation

While sentiment scores helped quantify how users felt about each park, we wanted to ensure those scores could be used to offer real applicable improvements to parks in the Charlotte-Mecklenburg area. To do this, we looked closely into the top terms that appeared most frequently in positive, neutral, and negative reviews, using results from our TF-IDF and chi-square analysis.

To achieve this, we grouped frequently used keywords into broader categories based on recurring themes in user reviews, allowing us to highlight the most commonly discussed aspects of park experiences. These themes were then linked to actionable recommendations, frequent negative mentions exposed areas needing improvement, while conversely positive patterns highlighted areas of parks worth maintaining or expanding on. This step bridged the gap between sentiment data and decision making, allowing us to provide insights that reflect community feedback and help prioritize where resources should be focused.

4 Results

For our analysis, a custom range was created to indicate the sentiment of reviews, reviews with a polarity score greater than or equal to 0.25 were considered positive. Similarly, reviews with polarity scores below 0 will be considered negative and all other polarity scores in between these two were considered to be neutral. Since there is no defined range that should be used in this type of research other the range chosen was completely up to our discretion, because of this these thresholds were slightly adjusted multiple times and after each adjustment results were reanalyses. From there we were able to compare the results based on using different range thresholds for polarity to make a more informed decision with the specific values to use for decision making, using the initial 1 to -1 scale as guidance. By choosing these specific thresholds we aimed to ensure that the proper sentiment was being associated with each review.

The results of polarity analysis analysis revealed that of all the text reviews, 2205 of them had positive sentiment meaning they had higher than a 0.25 polarity score; 770 of the reviews had neutral sentiment, with a polarity score between 0 and 0.25; and 123 of the reviews had negative sentiment, with a polarity score less than 0. Referring to table 1 we can see no parks had an average polarity score below 30%. We can see the low levels of negative reviews reflected here, of these negative reviews they came mainly from zipcodes 28202, 28217, 28216, and 28205.

Table 1: Parks and Their Polarity Scores

Park Name	Polarity Score	Zipcode
Freedom Park	0.4443	28203
Romare Bearden Park	0.4261	28202
Park Road Park	0.4258	28210
R.C. Bradford Park	0.4191	28078
UNCC Botanical Garden	0.4079	28262
Hornets Nest Park	0.4050	28216
Little Sugar Creek Greenway	0.40	28203
McAlpine Creek Park	0.3920	28226
Reedy Creek Park	0.3860	28215
Eastway Park	0.3842	28205
Fourth Ward Park	0.367	28202
Nevin Park	0.3659	28269
First Ward Park	0.3628	28202
Midwood Park	0.3553	28205
Clanton Park	0.3461	28217
Robert L. Smith Park	0.3433	28216

To extract features and sentiment bigrams and quadrigrams were used to give context to features. When separated by sentiment, either positive or negative, trends become evident. When leaving in descriptive adjectives we see good walk, basketball court, good disc golf, then children play, good family, and play area. These features highlight some important things parks give to the public, especially children. People enjoy using parks for a place to walk and to allow children to play outside. However they also love parks for amenities such as disc golf and basketball. These provide enrichment and activity for many people. On the other hand, negative review bigrams showed homeless people and disc golf closed.

Quadragrams were used to find more detail connected to these features. In regard to positive reviews "good play area children" appeared, then "spend time family friends," and "water features children play". While Negative reviews saw combinations such as "police patrols area city" appearing and "poisonous plants remember eyes," "People listen noise vehicles". These combinations show that highly positive reviews mention places for children to play and places to spend time with family and friends. Meanwhile, negative reviews show a story of fear, noise pollution, police presence, and dangerous conditions.

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Neutral reviews often mentioned "walk path," "homeless people," "splash pad," "playground children," and "hidden gem". This shows a wide range of features people are discussing in their reviews. Some positive features such as walking paths, splash pads, playgrounds, even calling some parks hidden gems. While some reviews mention homeless people. This can be concerning and would definitely deter people from bringing children to these parks.

5 Discussion

Multiple different steps and methods were taken during the analysis phase of this project, which offered different but complementary insights that contributed to offering a better understanding of what the important factors are that should be prioritized in order to improve park sentiment with the ultimate goal of boosting park attendance numbers. Multiple different steps and methods were taken during the analysis phase of this project, which offered different but complementary insights. These insights gave us a better understanding of the highest priority factors to improve park sentiment with the ultimate goal of boosting park attendance numbers. In the following sections, we will discuss the results of the analysis and explore how they can aid in identifying specific areas of improvement of parks in the Charlotte-Mecklenburg area, with the aim of encouraging more park usage and engagement.

5.1 Polarity Scores and the Effect of Park Locations

By averaging sentiment polarity across park names, we identified both the highest-rated and most criticized parks in the region. Freedom Park and Reedy Creek Park had some of the highest average sentiment scores, while others, such as Park Road Park showed more mixed reviews.The sentiment classification revealed that a majority of reviews were positive, indicating that park users generally have favorable experiences, while a less significant portion of reviews were either neutral or negative, highlighting recurring concerns. To explore potential geographic differences in public perception, sentiment scores were grouped and analyzed by zip code. Each park in the dataset was tagged with its corresponding zip code based on its address. This enabled an investigation into how park reviews varied by location within the Charlotte-Mecklenburg area.

The analysis revealed notable differences in sentiment distribution by zip codes. For example, the zip code 28202, which includes urban parks near Uptown, exhibited more neutral and negative sentiments, often related to concerns over parking availability and safety. Parks in suburban zip codes, like 28277 and 28269, received overwhelmingly positive reviews, highlighting amenities such as clean bathrooms, walking trails, and playgrounds. These findings suggest that geographic context like urban density and neighborhood affluence may influence park quality and visitor satisfaction. Incorporating analysis done by zip code allows policymakers to pinpoint specific communities where targeted improvements could have the greatest impact.

5.2 Implementation of Positive Keyword Usage to Identify Park Improvements

To identify which park features have the greatest impact on public sentiment, we extracted top bigrams and quadragrams from reviews, which are included in Table 2. Common phrases like 'disc golf,' 'walk trail,' 'basketball court,' 'tennis court,' and 'soccer field' highlight the value of accessible recreational spaces that support physical activity and social interaction. These features consistently contributed to positive sentiment and should be prioritized in park planning.

Table 2: Top Sentiment Feature Phrases from Reviews

Type	Phrase	Freq.
Bigrams	Disc golf	403
	Walk trail	130
	Basketball court	65
	Playground children	59
	Splash pad	44
	Picnic tables	40
	Tennis court	31
	Soccer fields	31
	Take children	25
	Fresh air	22
	Nature center	21
	Plenty space	20
	Homeless people	19
Quadragrams	Disc golf course quality	20
	Challenging Disc golf course	10
	Basketball court tennis court	8
	Tennis court basketball court	4
	Children disc golf course	3
	Right next light rail	3
	Disc golf course closed	3
	People listen noise vehicles	2
	Children wide open spaces	2
	children friendly dog friendly	2

Child-specific phrases such as "playground children" and "splash pads" appeared frequently, showing that patrons highly value amenities geared toward younger visitors. Enhancing or implementing family-friendly infrastructure may lead to improved satisfaction and increased attendance.

In addition, terms such as "nature center," "fresh air," and "plenty space" reflect appreciation for the natural environment. Preserving scenic views, adding green elements such as trees or water features, and maintaining open spaces were all associated with more favorable reviews, further reinforcing the importance of natural design in promoting positive park experiences.

5.3 Implementation of Negative Keyword Usage to Identify Park Improvements

Similarly to how trends were identified using positive terms to highlight key areas for improvement, the same approach was applied to the negative features. Although they reflect unfavorable experiences, these negative factors offer equally valuable insight into what aspects of parks may be discouraging visitors from attending and therefore offer more suggestions on improvements that could be made to boost attendance.

The key negative sentiment phrases that were identified include "right next light rail," "homeless people," "people listen to noise vehicles," and "Disc golf course closed." These phrases identify issues related to noise pollution, safety concerns, and random park

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closures as key negative factors affecting park user experience. One way to address noise pollution would be implementing more natural elements to parks, such as more trees or landscaping that could aid in blocking out external noises caused by nearby cars and trains. This would improve green space, while also reducing noise pollution.

In regards to addressing park goers safety concerns due to the presence of homeless people, potential solutions would involve enhancing park security to make patrons feel more safe. This could include implementing park security, or at the very least hourly patrols. In addition to physical security, features such as security cameras and improved lighting throughout the park could improve the park goers perceived safety. These safety measures could lead to improved sentiment and contribute to a boost in park attendance.

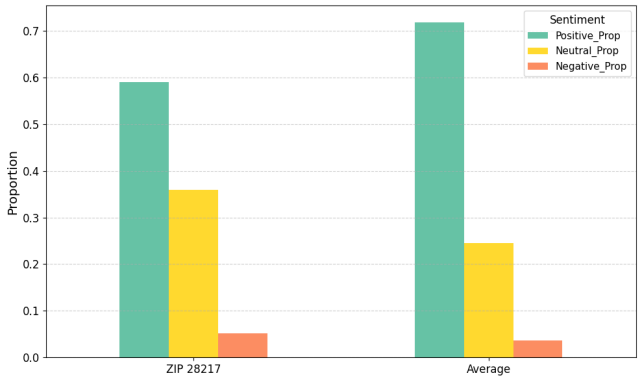

Figure 2: Zipcode: 28217 Compared to Overall Average

5.4 Notable Sentiment Trends in ZIP Code 28217

Among all zip codes analyzed, 28217 stood out as a statistically significant outlier in terms of sentiment distribution. This area showed a notably low proportion of positive reviews (z = -2.47) and an unusually high rate of neutral sentiment (z = 2.55). Although negative sentiment was only slightly elevated (z = 1.09), the combination suggests that parks in this area may not be perceived as actively problematic, but rather as underwhelming or unmemorable. This lack of enthusiasm indicates that these parks may not meet visitor expectations in a meaningful way. As such, 28217 presents a strong candidate for targeted interventions that enhance appeal and encourage more positive public engagement. The following visual represents the trend mentioned above.

The sentiment distribution for ZIP code 28217, compared to the overall average, is visualized in Figure 2, illustrating the gap in positive and neutral sentiment.

5.5 Discussion of Limitations

Like all research, this study comes with limitations. The most notable was the lack of available data on daily park attendance. Since public parks often don't track attendance, we had no baseline for comparison. Similar studies used tools like heat map cameras to estimate visitor counts [8], but we didn't have access to such resources. As a result, we worked under the assumption that boosting positive sentiment among park users would likely increase park usage.

Another limitation was the imbalance in review sentiment. Most user reviews were positive, with fewer neutral or negative ones. We tried to offset this by targeting parks with lower star ratings, but this had limited effect. Despite this, we determined that all types of sentiment – positive, neutral, or negative– held value for identifying areas of improvement.

Future research could address these gaps by incorporating direct attendance tracking and ensuring a more balanced sentiment dataset. It should also account for the limits of relying on online reviews, which may not represent the broader community. Additionally, it could explore practical barriers, such as budget or staffing issues that may hinder the implementation of suggested improvements.

6 Conclusion

This research addressed the growing concern of excessive screen time among children, a trend that has intensified since Covid-19 pandemic. As a healthier and more engaging alternative, we explored how Charlotte-Mecklenburg's public parks could be better utilized to support outdoor recreation and reduce reliance on digital entertainment. To investigate this, we conducted sentiment analysis on Google user reviews to identify patterns in how residents perceive local parks and what factors most influence their experiences.

Our findings highlighted five key areas that could meaningfully enhance public sentiment and park usage: expanding recreational amenities like walking trails and sports fields, increasing child-friendly infrastructure such as playgrounds and splash pads, preserving and enhancing natural features like trees and green space, mitigating noise pollution through natural sound barriers, and improving safety through lighting, cameras, and security measures. By focusing on these priorities which were drawn directly from the voices of park users, we can conclude the Mecklenburg County Park and Recreation Department can increase the popularity of parks making them more accessible, appealing, and healthy community assets. In doing so, they offer a practical solution to the growing screen time issue by encouraging more outdoor and active engagement for children.

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