Using Sentiment Analysis and Topic Modeling to Analyze Public Perception of Air Travel

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Abstract

Like many other industries, air travel was greatly affected by the COVID-19 pandemic. Airlines and airports had to rely on public sector information to enforce guidelines that ensured the health and safety of travelers. In response to the inception of COVID preventative policies, one of the avenues that travelers have been able to freely express their opinions has been through online reviews. It is important to evaluate public opinion of new laws and policies to ensure transparency. This study uses online reviews of airlines and airports from 2017 to the present day to analyze the effect of COVID-19 preventative policies on the public perception towards air travel. Supervised learning with VADER sentiment analysis was used to determine the change in opinion from 2017 to the present day. Unsupervised learning with LDA topic modeling was used to assess air travelers' areas of concern both before and after the pandemic. This study reveals that the implementation of COVID-19 related policies has worsened the public perception of air travel and has caused new concerns to emerge.

Keywords: COVID-19, Coronavirus, Pandemic, Air Travel, Public Opinion, Online Reviews

1. Introduction

As of April 2022, there have been a reported total of 500 million cases of COVID-19 globally (WHO, 2022). The COVID-19 pandemic has been a great disruptor to many industries, including the air travel industry. In a global health crisis, it is expected of organizations in the public sector to provide information which can be used to create policies that ensure the protection and safety of people across all industries and institutions. During the COVID-19 pandemic, public health organizations, e.g. Centers for Disease Control and Prevention (CDC, 2022), and World Health Organization (WHO, 2022), were forced to implement policies, such as mask wearing, COVID testing and social distancing, to reduce human-to-human interaction to help prevent the spread of the virus (TSA, 2022). Doing so consequently changed the process of air travel and the overall experience of the traveler. While in an unprecedented situation such as a pandemic, it is important to rely on the public sector for guidance, it is equally as important for people affected by these changes to be able to freely express their own opinions on the implementation of new policies. As travelers are poised to keep up with ever-changing COVID preventative guidelines, they must comply with protective measures deemed appropriate by their location of departure, destination and air carrier. In the case of flying during a global health crisis, travelers can openly express their own experiences online in the form of reviews.

This study aims to explore the impact of COVID-19 related policies on the public perception of air travel. In particular, we aim to look at how travelers' perceptions have changed since March 2020. Additionally, we observe what concerns have increased and emerged since preventative measures have been executed via public sector information. Public compliance to COVID preventative measures has brought about a great deal of change in the flight experience which has undoubtably altered the opinions travelers have about flying. The implementation of new policies, which have been enforced for safety reasons, have resulted in a shift in areas of travel-related concern which we aim to recognize.

2. Related Work

When implementing policies in a health crisis, public opinion is a primary constraint (Treloar & Fraser, 2007). Needle and syringe programs have been implemented by the public sector in Australia to battle the opioid epidemic. Failure to consider public opinion when releasing information about these programs has resulted in instances of hasty political response which in turn leads to negative public reaction.

The COVID-19 pandemic has resulted in rapidly changing and at times contradictory public policies (Sheluchin et al., 2020). The public health sector has put forth policies throughout the pandemic and then had a change of heart. For example, public health agencies in both the US and Canada have revised guidance on the utility of masks. In 2020, a research study was conducted to gauge the public repose to the policy reversal of mask usage in Canada. It was discovered that throughout the tumultuous changes in policy, Canadians remained compliant with the guidelines of their country.

According to a recently published case study, Italian air travelers flying during the pandemic were increasingly more concerned about compensations, cancellations than the COVID-19 virus itself (Piccinelli et al., 2021). This analysis also indicated that travelers' feelings were mixed and unpredictable. Persecutive air travelers became apprehensive with the irregularity of flights and took to online platforms to express their concerns.

One major area of concern throughout the COVID-19 pandemic has been the implementation of vaccine mandates. A study published in the Journal of the American Medical Association in 2020 measured the US public attitude towards COVID-19 vaccine mandates (Largent et al., 2020). This study revealed that at the time, 61.4% of

Americans were willing to get a COVID-19 vaccine once available. This leaves almost half of the United States population with a negative perception of this specific COVID-19 preventative policy. When dealing with a polarizing issue such as the implementation of policies to prevent the spread of COVID-19, a broad public response of varying opinions should be expected and considered.
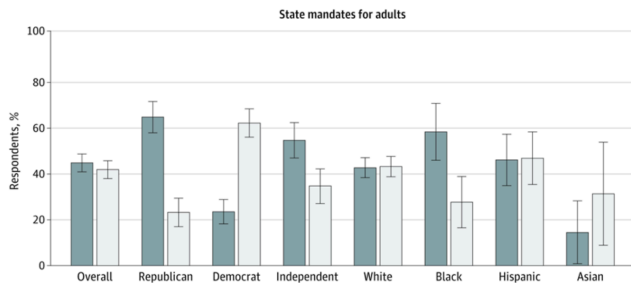

Figure 1: Acceptability of vaccine mandates among American adults (Largent et al., 2020)

3.   Data

In order to gather traveler insights, data was generated from online reviews of airlines and airports from June 2017 until March 2022. The airlines being reviewed in our data were Delta Airlines, American Airlines and Southwest Airline which are the top three most flown airlines in the United States (Salas, 2022). Airport reviews came from the United States, Canada and the United Kingdom. These reviews were obtained from TripAdvisor.com and AirlineEquality.com using a web scraping tool built from the Selenium web driver library. Both websites are platforms which allows travelers to connect and share travel related experiences through reviews and comments. The total amount of reviews obtained in this study was 18,492.
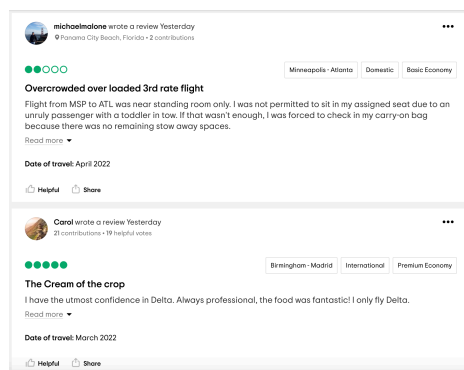

Figure 2: An example of two TripAdvisor reviews for Delta Airlines (TripAdvisor, 2022).

4.   Method

The first step taken before analysis began was to organize the data into time based categories. Using the pandas library in python, reviews were either categorized as 'before covid' or 'after covid' and placed into respective csv files. For the purposes of this study, March 15th 2020 was defined as the beginning of the pandemic period since that was when the CDC began implementing its policies. Once

the data was organized, the natural language toolkit (nltk) python library was used to preprocess the text in the review data. In the preprocessing stage, non-character text such as punctuation, emojis and stop words were removed. Stop words are words in a text that do not contribute any significant meaning to the text as a whole. N-grams were also grouped together, clusters of n amount of words that have a singular meaning when grouped together, such as "customer service" and "social distancing".

An analysis of the preprocessed data was conducted which began with sentiment analysis. To perform sentiment analysis, the Valence Aware Dictionary for Sentiment Reasoning (or VADER) tool was used which is included in the nltk library. This provided a numerical sentiment score to each review, -1 being the most negative a review can be and +1 being the most positive a review can be. The average sentiment score was also calculated for reviews before and after COVID-19 so the change in public opinion of air travel could be observed.

To extract the main concerns of air travelers, topic models of the reviews were created using Latent Dirichlet Allocation (LDA). LDA topic modeling uses statistical methods to group related words in a document together to create 'topics' discussed in the document. This method was applied on four different categories of reviews which were separated based on sentiment score. The four categories were positive reviews before COVID-19, negative reviews before COVID-19, positive reviews after COVID-19 and negative reviews after COVID-19. A coherence score was calculated to determine how many topics should be generated for each review category to provide the most coherent and readable information. Topic Modeling resulted in a top-k ranking for each category of reviews. This provided a list of the most frequently used words in each topic.

ALGORITHM 1:

```
READ Review_Data
FOREACH review
IF review date is after "3-15-2020"
THEN Add review to After_Covid
ELSE Add review to Before_Covid

FOREACH review in After_Covid
COMPUTE Avg_Sent_Score
IF Avg_Sent_Score > 0.7
THEN Add review to Pos_After_Covid
ELSE Add review to Neg_After_Covid
FOREACH review in Before_Covid
COMPUTE Avg_Sent_Score
IF Avg_Sent_Score > 0.7
THEN Add review to Pos_Before_Covid
ELSE Add review to Neg_Before_Covid
FOR Pos_After_Covid, Neg_After_Covid, Pos_Before_
Covid, Neg_Before_Covid
COMPUTE topic model
Output top-k rankings
```

5.   Results

The results from this sentiment analysis indicated that since COVID-19 policies have been put in place by organizations such as the CDC and the WHO, the public perception of air travel has become increasingly more negative. The results also indicate that this negative shift in the public's opinion was greater in airline reviews than airport reviews.
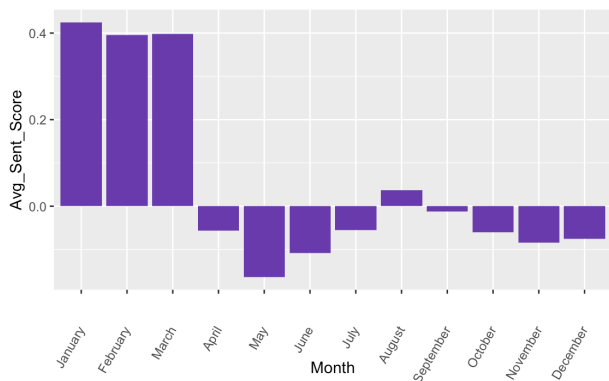

Figure 3: Average Sentiment Score of reviews in 2020 by month.
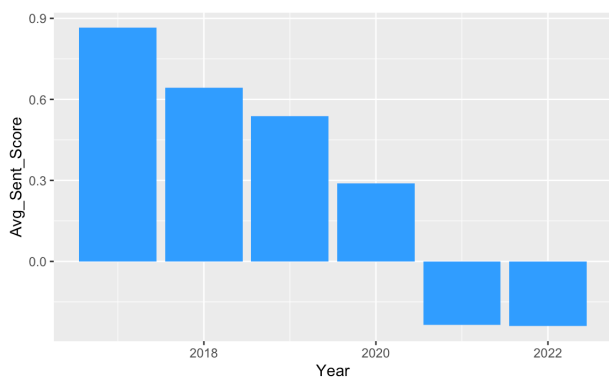

Figure 4: Average Sentiment Score of reviews from 2017-2022 (even years labeled).

According to the topic models that were generated, air travelers' greatest areas of concern before the pandemic were waiting time, customer service quality and unexpected changes such as flights being rescheduled or seats being changed. After the pandemic began, these concerns persisted, however, new concerns pertaining to COVID-19 preventative guidelines emerged. The most

common concern air travelers had after these policies were in place was how mask wearing mandates were being enforced unprofessionally by airline and airport staff. Other concerns noted were how air travelers were disappointed in how poorly COVID-19 guidelines were being followed in airports and on airplanes. Overall, the implementation of new COVID-19 policies from public sector organizations added to the potential concerns of air travelers.
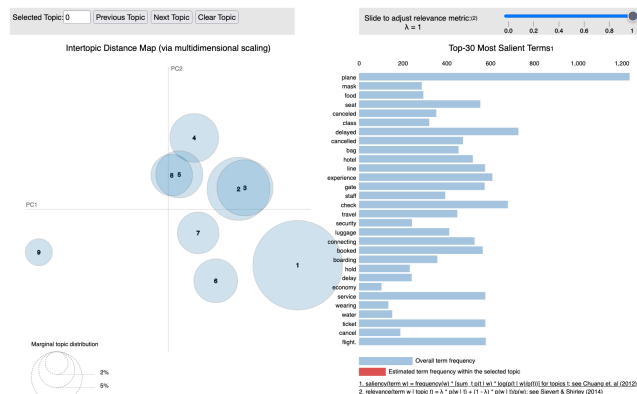

Figure 5: Topics and top-k ranking for negative reviews after March 15th 2020.

Figure 6: Word cloud for negative reviews after March 15th 2020.

6.   Conclusion & Future Work

This study used sentiment analysis and topic modeling to examine the impact of public institutions (CDC or WHO) placing new restrictions on a private industry (air travel) due to a pandemic. The emergence of COVID-19 policies in March of 2020 significantly impacted air traveler's opinion of flying, as measured by change in sentiment score. This study provides initial support that public guidelines negatively impact the travelers' opinion of airports and airlines and increased the number of negative
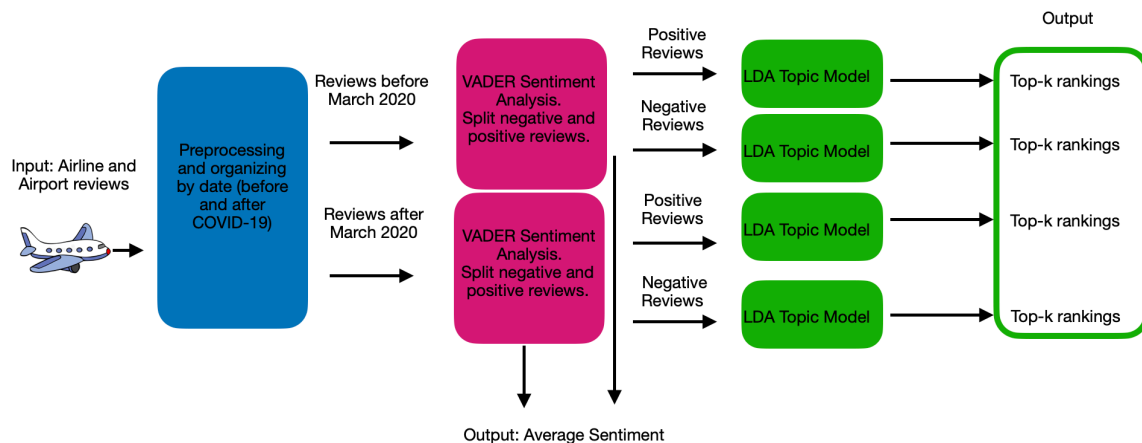
Figure 7: Diagram of the approach of the study.

sentiments associated with air travel. Air travelers continue to have the same concerns related to flying pre-pandemic. Additionally, air travelers now have new concerns related to public guidelines crafted to maintain the health and safety of air travelers throughout the pandemic.

As treatments for COVID-19 increase and numbers of infections continue to trend downwards, COVID-19 preventative policies are slowly being pulled back. On April 18th 2022, several airlines announced that mask-wearing was optional on their aircrafts (Vogt et al., 2022). In terms of future work, it would be interesting to see how public sentiment towards flying will shift in a more positive direction as the process of air travel begins to become more similar to how it was pre-pandemic.

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