

COVID-19 Contact Tracing App Reviews Reveal Concerns & Motivations Around Adoption

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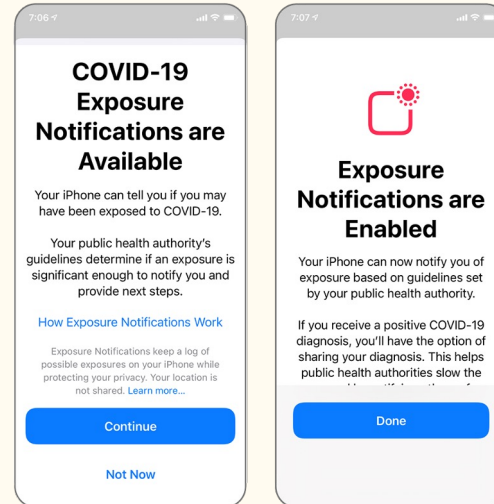
Sukanya Joshi
MSE Data Science @ University of Pennsylvania

Background

- Google and Apple's Exposure Notifications Systems (ENS) complemented contact tracing efforts in the COVID-19 pandemic.
- ~ 1 in 14 people had downloaded apps in states where one was available.



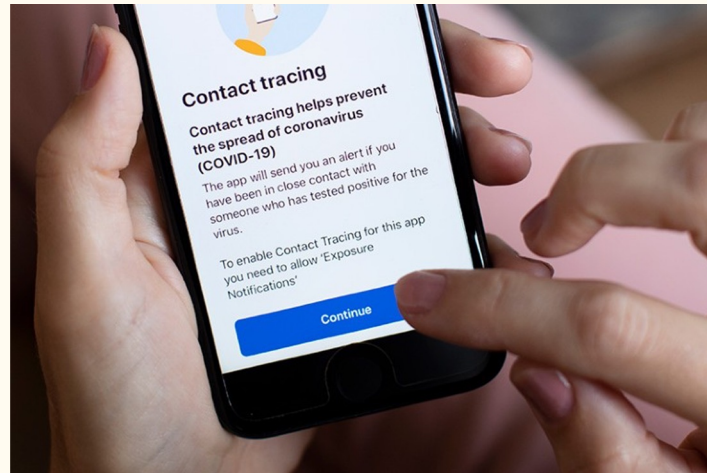
<https://tinyurl.com/covidensappimage>



<https://tinyurl.com/covidexpnotifs>

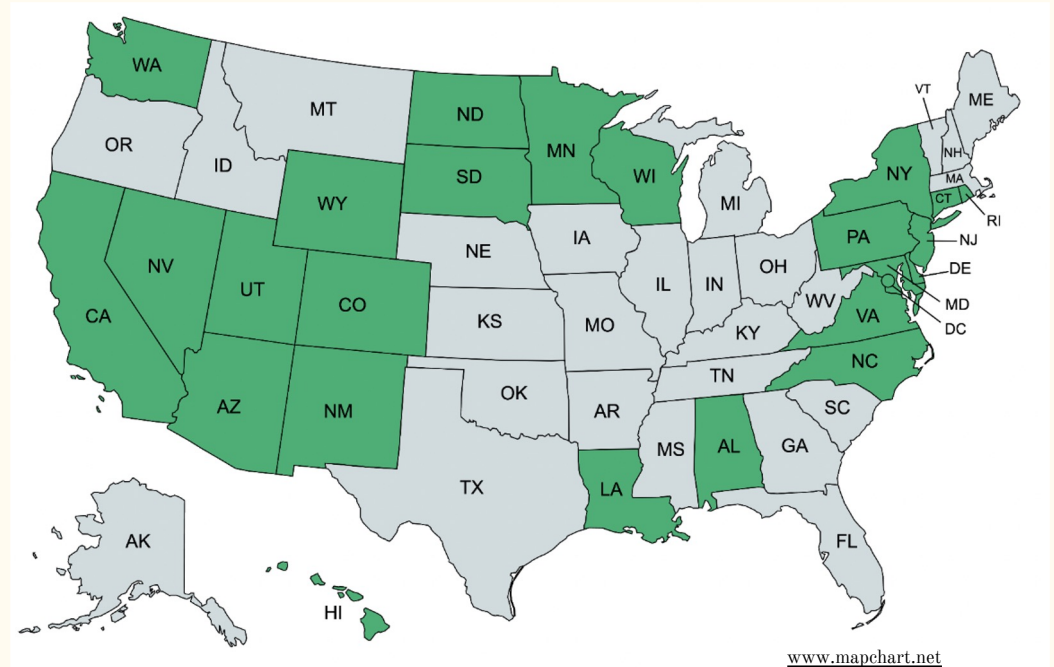
Objectives / Research Questions

- Due to its low uptake, what are the motivations and concerns of users who downloaded ENS apps?
- What are the common themes found within the positive, neutral, and negative app reviews?



Data Collection

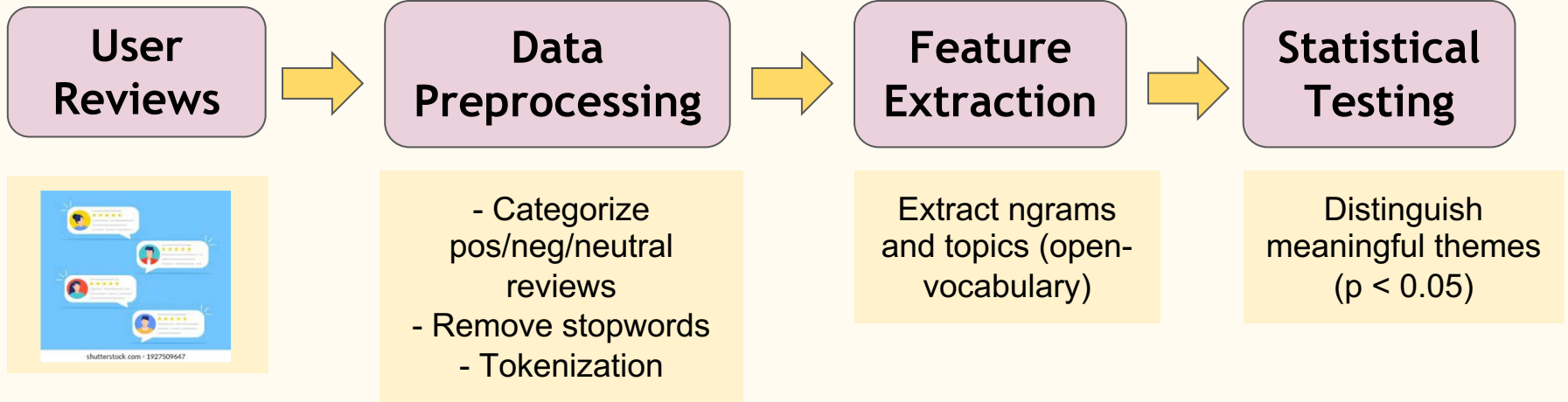
- iPhone & Android Reviews
- # of User Reviews: 7,622
- # of States: 26
- Timeframe: 4/7/20 - 3/31/21
- Languages: SQL/Python



Methods

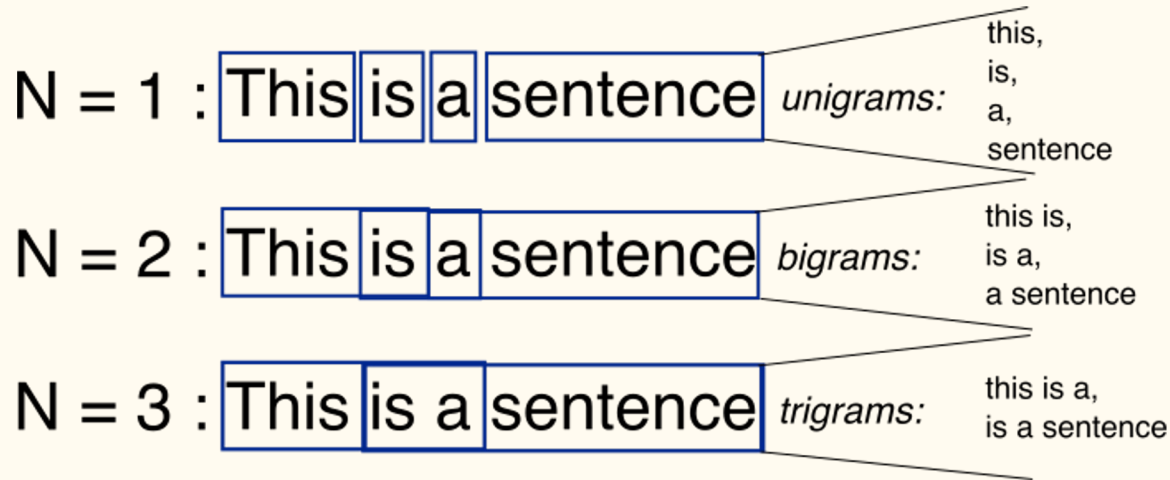
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Overview Flowchart



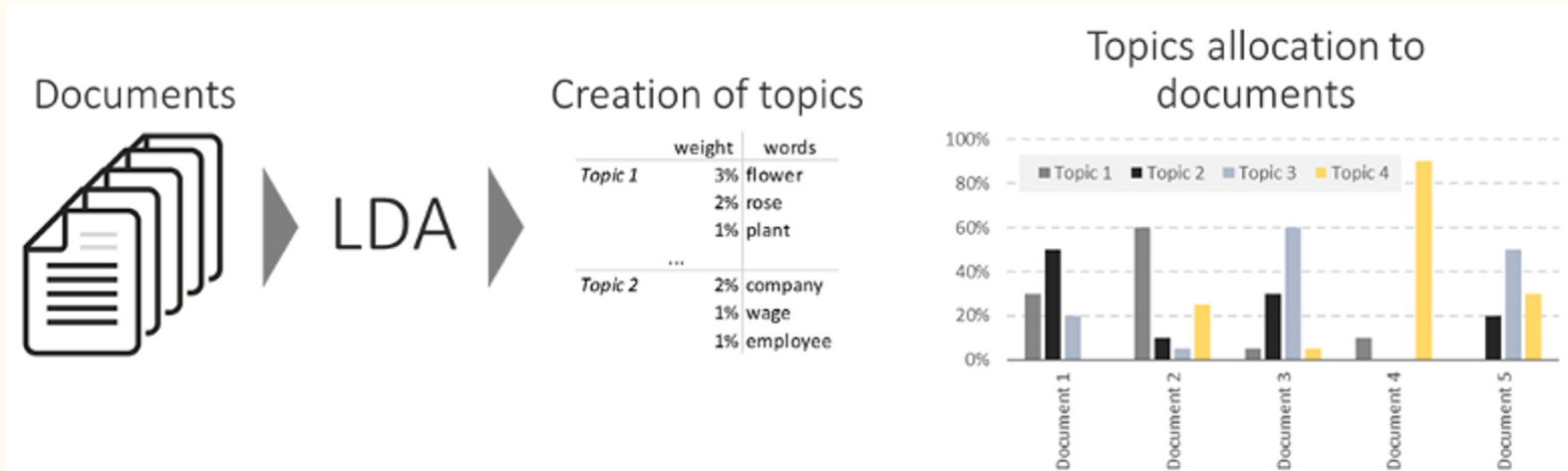
Feature Extraction: Ngrams

- Extracted 1-, 2-, and 3-grams of all reviews
- Found words/phrases highly associated with positive, neutral, negative themes



Feature Extraction: Topics

- Topics: Clusters of co-occurring words in the data – generated using LDA.
- Calculated probability of each topic in every review
 - Used this to understand the most common themes for positive, negative, and neutral reviews



Why LDA?

- Extracted topics using CTM and NMF techniques, in addition to LDA.
- Calculated & compared coherence scores of all three methods
 - LDA had the highest coherence scores for all measures, so we chose this method.

Coherence Scores using LDA, CTM, and NMF			
Coherence Measure	LDA	CTM	NMF
u_mass	-6.52	-7.90	-8.54
c_v	0.37	0.20	0.23
c_uci	-0.95	-2.43	-3.43
c_npmi	0.00	-0.10	-0.13

Differential Language Analysis & Statistical Testing

- Understand how ngrams and topics vary across user review categories.
- Perform statistical testing to distinguish significant features
 - Control for multiple hypothesis testing (Benjamini-Hochberg p-correction)
 $p < 0.05$ for indicating meaningful associations
 - Understand how feature dimensions are different for positive, negative, and neutral reviews

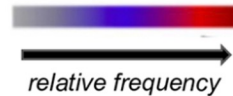
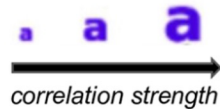
Results

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Words and phrases associated with positive/negative reviews



a) Positive Ratings



b) Negative Ratings

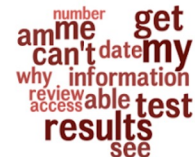
Topics Associated with Negative Reviews

Unable to get Exposure Notifications



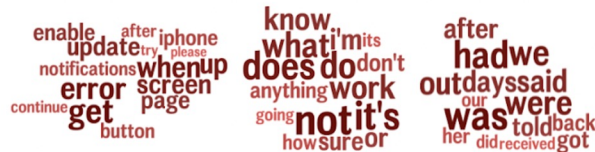
OR = 3.92 (3.55, 4.30) OR = 2.21 (2.19, 2.23)

Unable to Review COVID-19 Test Results



OR = 1.79 (1.76, 1.81)

Functional Issues

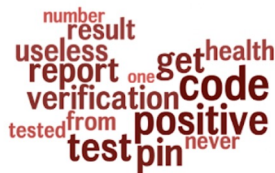


OR = 1.69
(1.67, 1.72)

OR = 1.40
(1.38, 1.43)

OR = 1.25
(1.23, 1.28)

Issues with Verification



OR = 1.63 (1.61, 1.66)

Drains Battery



OR = 1.24 (1.22, 1.27)

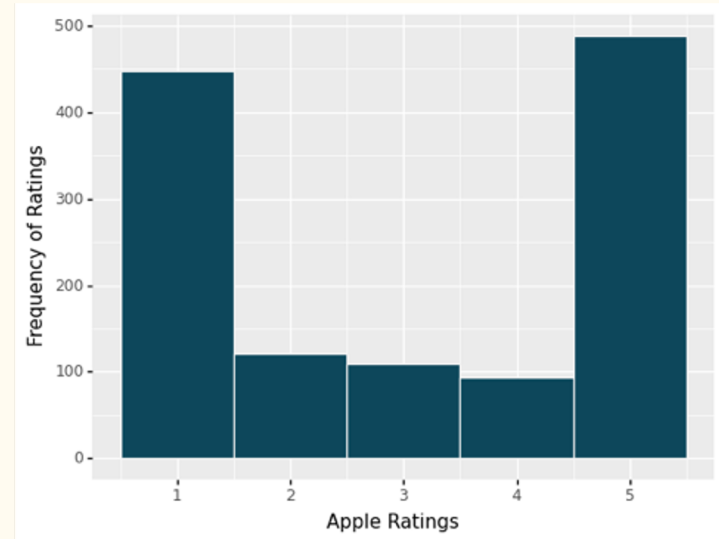
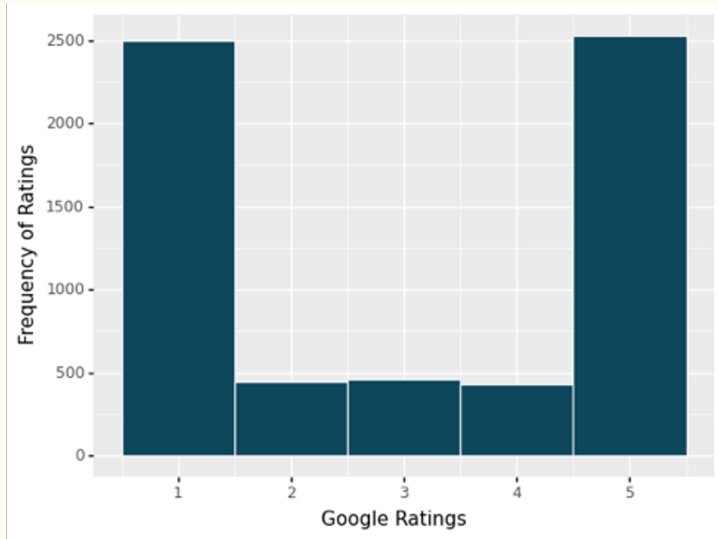
Hoax, Government Control



OR = 1.15 (1.13, 1.18)

Overall Distribution of Ratings

- $\approx 78\%$ of the app reviews were either categorized as a 1-star or a 5-star rating



Discussion / Impact

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Discussion

- Positive reviews discussed ease of use, encouragement for others to download the app, as well as engage in other COVID-19 precautions.
- Negative/neutral reviews discussed issues with app functionality, such as installation errors, battery drainage, inaccuracies in tracking location, etc.

x

★★★★★

Niraj4, 10/19/2020

Review from Information Security officer

This is a great app, designed with privacy first in mind. There is no way for anyone to know your information.

Let your friends and family know and ask them to download the app. It can save their life. The more people download it, the better it becomes.

I had a colleague receive a notification about possibly being exposed. He went to get tested and sure enough he was positive. He did not have symptoms but he self quarantined and saved his elderly parents from exposure. Download and spread the word! We can fight this virus out together.

x

★★★☆☆

R5A9, 11/13/2020

Exposure Alert can't work if county health departments don't have the info to provide

Sadly the app has been available for over a month and there are less than 330k downloads.

To make matter worse, the exposure alert feature is a complete waste. I tested positive this week (test Monday, results from lab Wednesday morning, finally contacted by Ocean County Health Department Thursday afternoon). When I asked the OCHD person that called about the tracking number to enter into the app she had no idea what I was talking about yet claims to have been doing Ocean County contact tracing since March. She said she'd make a call and get back to me. I thought that may have meant same day, but it's now Friday and no call back.

I wanted this app to work . I've had it installed since early October when there were less than 100k users, but in a state with 9 million people to have less than 330K download it and for county health departments to have no clue (or the information to provide) a month after release, this is not going to help reduce the number of cases in the state.

Limitations

- One of the largest barriers to success for ENS apps was getting people to download these apps
- Individuals who had non-extreme sentiments were less likely to comment.
- Themes could vary by platform (Google vs Apple) and by state but the sample size was not powered to compare insights by platform

Conclusion / Impact

- Uptake was the biggest barrier to success as stated by all categories of reviews
 - Both positive/negative reviews suggested that more people should download
- App developers can fix bugs/issues to increase user engagement in the future
- States can better position themselves in the future with this feedback
 - Provide incentives and enhance marketing strategies to get more people to download



<https://tinyurl.com/covidstopspread>



<https://tinyurl.com/covidalertimage>

Collaborators



Dr. Sharath Guntuku



Dr. Erica Dixon



William Ferrell



Dr. Kevin Volpp



Dr. Raina Merchant

Thank You So Much!



Scan to See Publication

Dixon, E. L., **Joshi, S. M.**, Ferrell, W., Volpp, K. G., Merchant, R. M., & Guntuku, S. C. (2022). COVID-19 contact tracing app reviews reveal concerns and motivations around adoption. *Plos one*, 17(9), e0273222.