Encouraging COVID-19 Vaccination in the US

Understanding hesitancy

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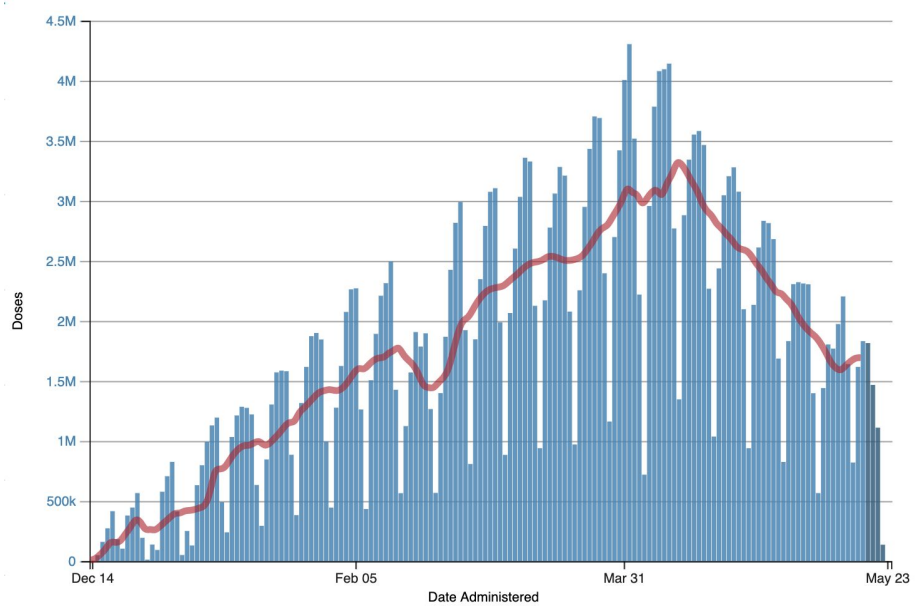
Agenda

- Challenge statement: What and why
- My approach and caveats
- Overview of the data sample and population
- Machine learning results
- Recommendations for further analysis

Photo by cottonbro from Pexels

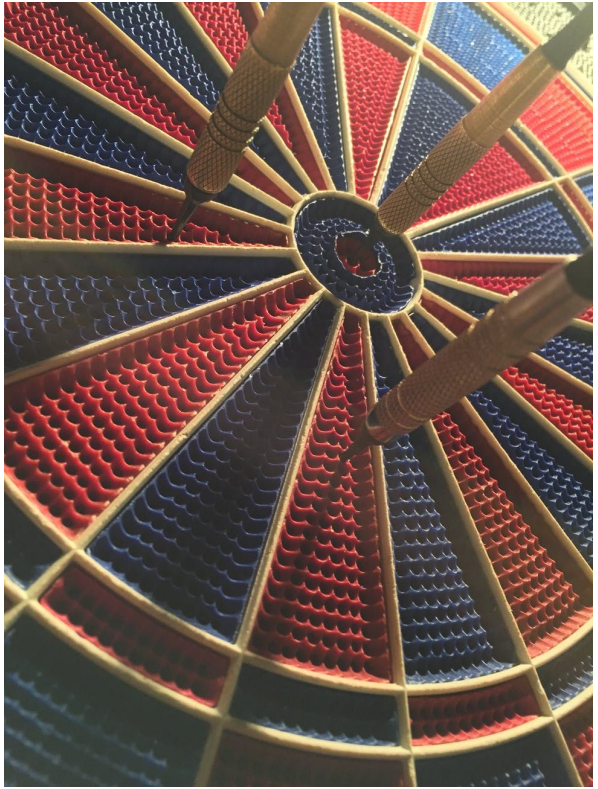
The challenge: Declining COVID-19 vaccination rate

- State and local governing bodies around the US are asking: **how can we encourage more people to get vaccinated sooner?**
- Percentage of vaccinated residents is a key metric used to decide when and how to lift restrictions
- Vaccine doses administered per day initially increased, but **has been declining since mid-April.**
- **Only 61% of adults have received at least one dose** as of May 22, so there are holdouts.
- Our goal is herd immunity and this is probably not enough yet

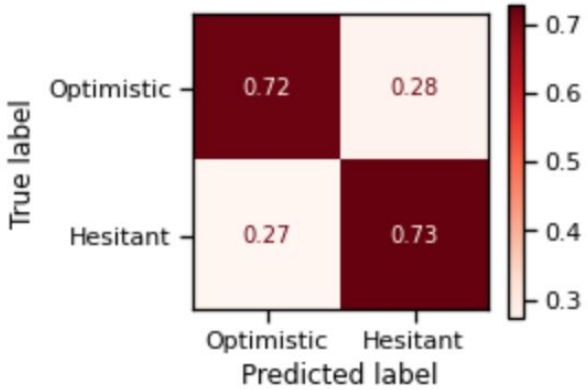


Goal of this analysis

- State and local governments are already offering perks and even cash stipends or lotteries to encourage people to get vaccinated. But this is a broad and costly approach.
- **Using data, can we recommend more targeted approaches as alternatives or in parallel?**



My Approach



- Trained machine learning models on US Census Bureau Household Pulse Survey Data to **predict vaccine hesitancy or optimism**
- Analyzed top predictors of hesitancy from these models to try to answer the questions:
  - What, if any, are **common characteristics among the vaccine hesitant**?
  - Do hesitant people with **different characteristics give different reasons** for their hesitancy?

Data used for analysis

- US Census Bureau's Household Pulse Survey
  - Random statistical samples from all 50 states and top 15 metro areas
  - Adults 18 years or older
  - Used data from survey conducted March 3 to March 15, 2021
  - Public microdata sample of ~78,000 responses
- Survey questions included:
  - How life had changed for the household during the pandemic
  - Vaccine doses received, intent to be vaccinated, and reasons why if did not definitely intend to be vaccinated
  - Information such as family size, housing situation, state or metro area, employment status, income, age, race and ethnicity

Defining vaccine optimism versus hesitancy

A respondent was considered **Optimistic** if:

- They had received at least one dose

OR

- Said they **Definitely Do or Probably Do intend** to get vaccinated in the future

A respondent was considered **Hesitant** if:

- They had not received any doses yet**

AND

- Said they **Probably Do Not or Definitely Do Not intend** to get vaccinated in the future

** Eligibility was not yet expanded to all adults at the time they were surveyed

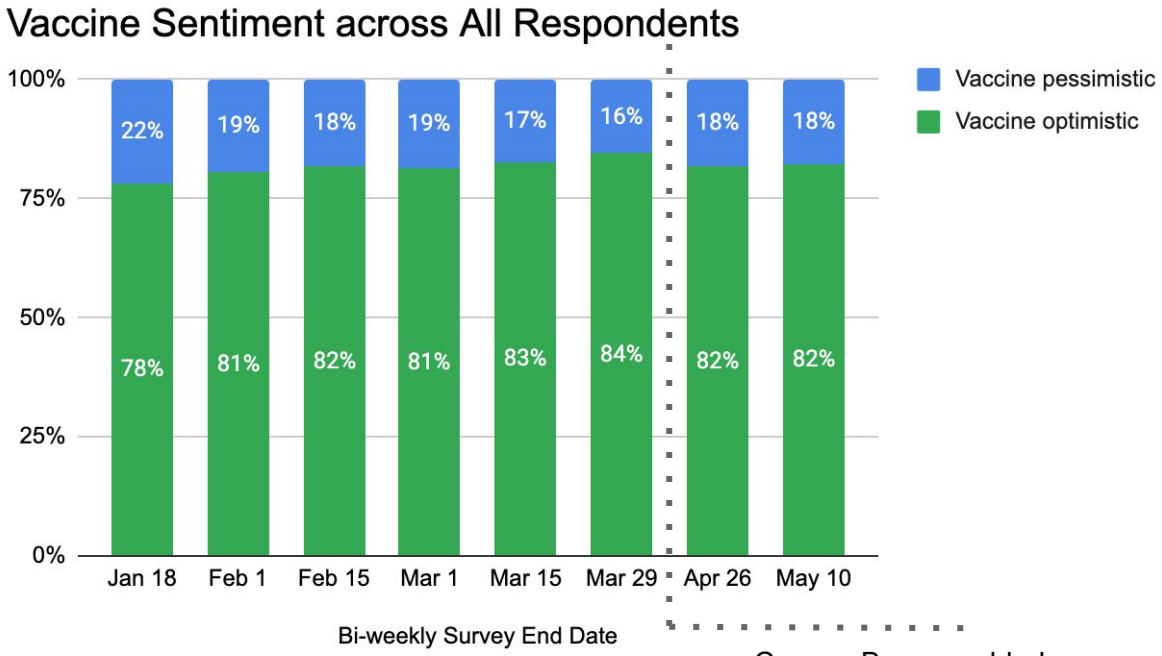
Caveats

- Respondents were surveyed in early March. More recent surveys may reveal different trends and importance in predictors
- Some groups are over- or under-represented based on who actually responded to the survey
    - In this survey, based on comparing population percentages to 2020 census statistics:
        - White respondents are over-represented
        - Asian respondents are slightly under-represented
        - Black and Hispanic/Latinx respondents are far under-represented

Sample and Population Overview

Vaccine sentiment remains fairly steady

- Vaccine sentiment does not appear to be changing over time

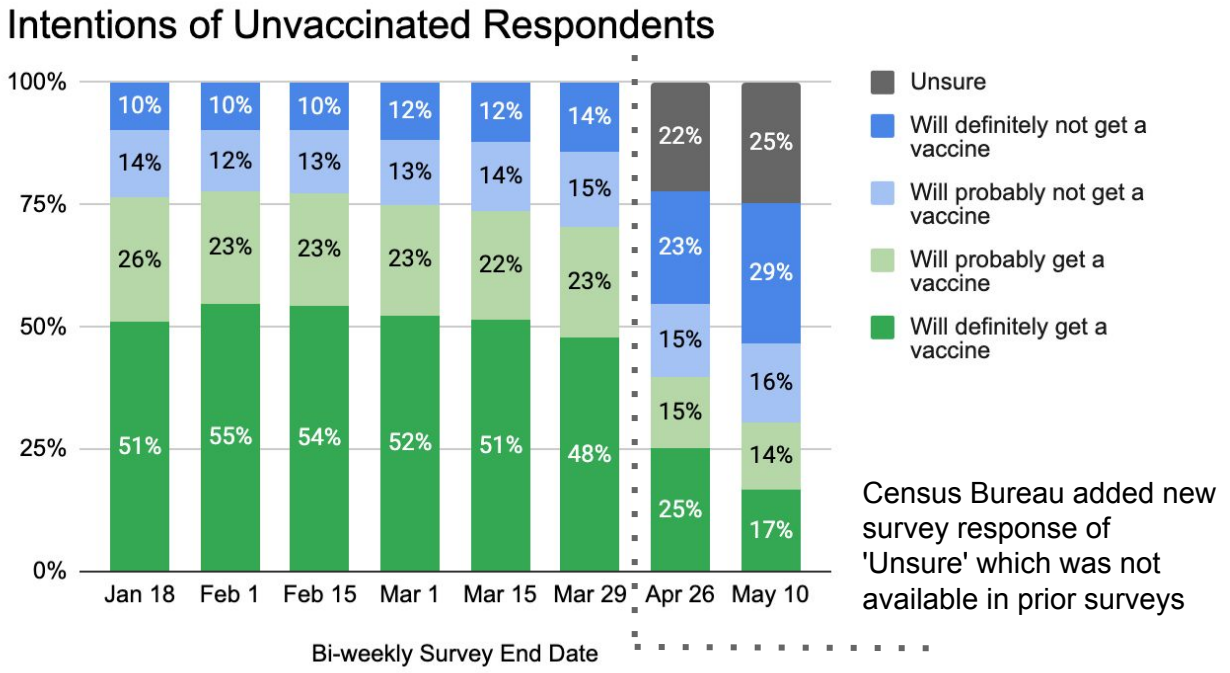


Census Bureau added new survey response of 'Unsure' -- here considered pessimistic

Source Data: https://www.census.gov/programs-surveys/household-pulse-survey/data.html
Population is all survey responses; not limited to publicly available microdata samples

People who want the vaccine are getting it

- All adults became eligible for vaccine appointments as of April 19th
- As time goes on, a higher proportion of the unvaccinated are hesitant (or unsure)

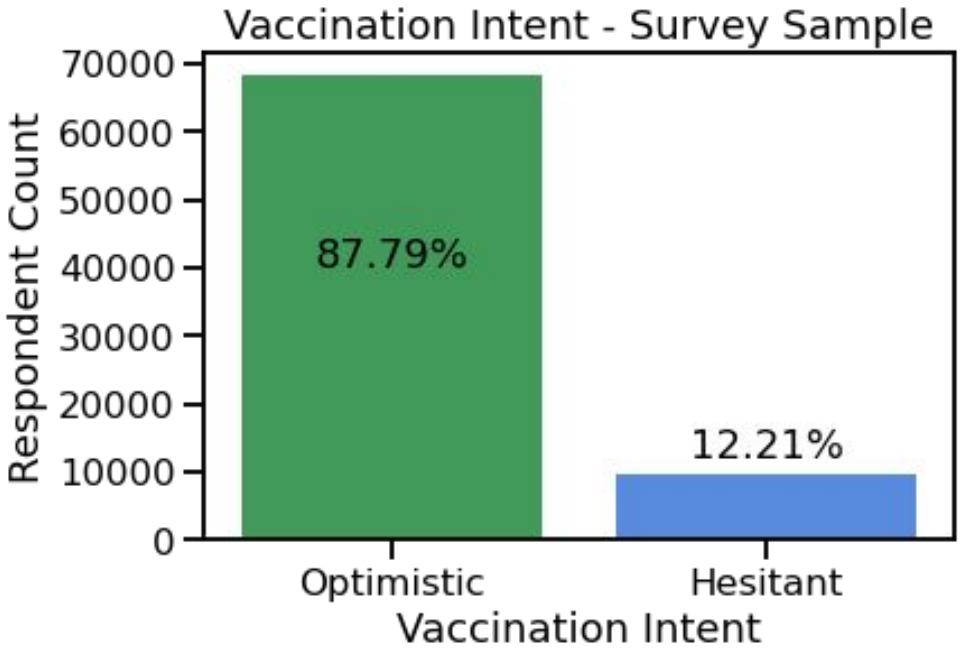


Census Bureau added new survey response of 'Unsure' which was not available in prior surveys

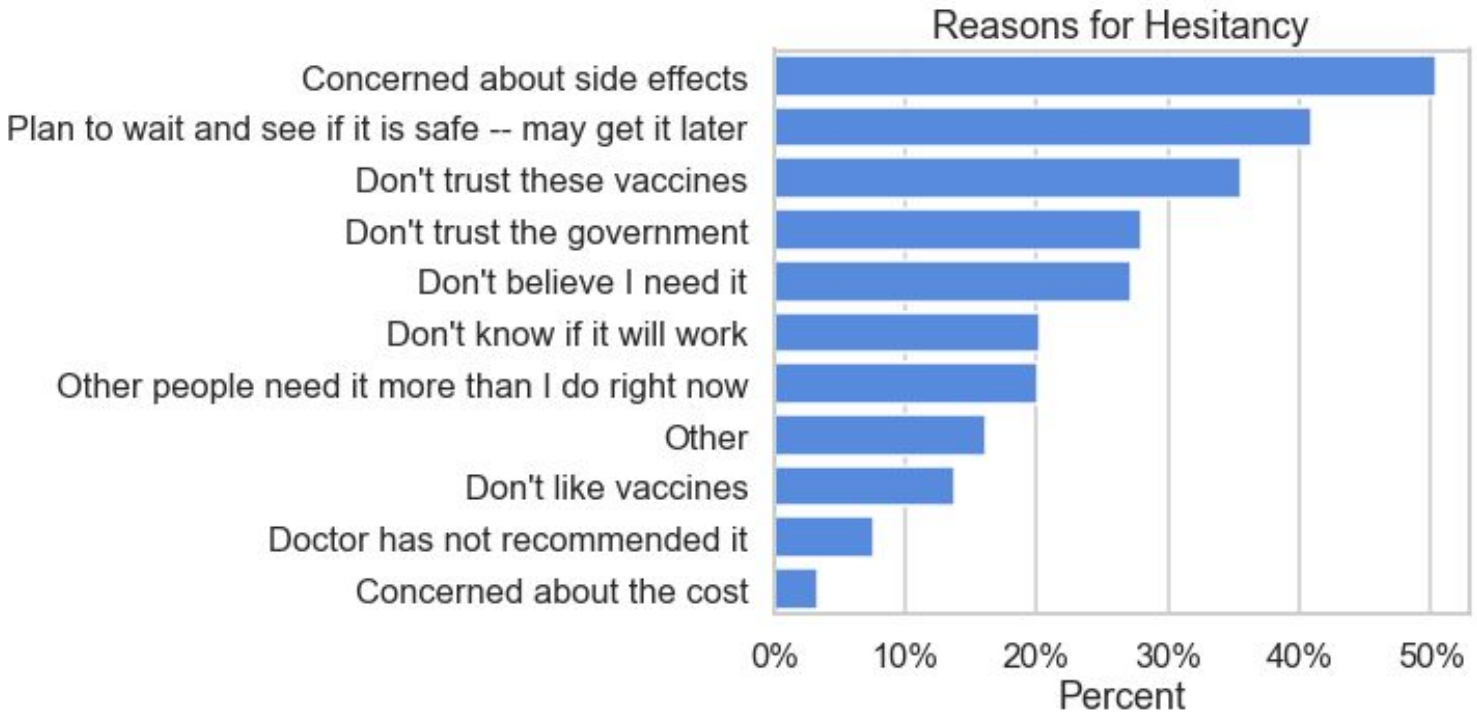
Source Data: https://www.census.gov/programs-surveys/household-pulse-survey/data.html
Population is all survey responses; not limited to publicly available microdata samples

Vaccine Intent across our survey sample

- Our microdata sample is somewhat more optimistic
  - 12% pessimistic
  - 88% optimistic
- Entire March 15 survey respondent population was
  - 17% pessimistic
  - 83% optimistic

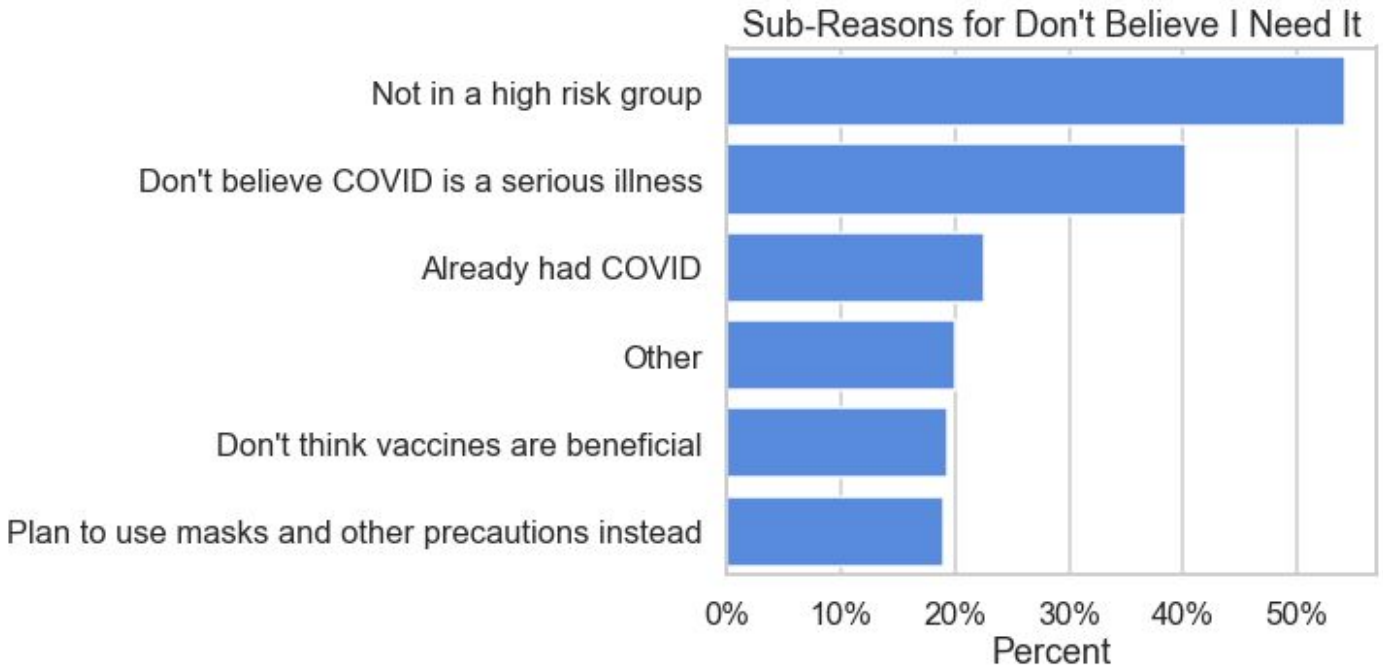


Reasons for Hesitancy



Respondents could select more than one reason, so **percentages will not sum to 100%**

Sub-Reasons for "Don't believe I need it"



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Machine Learning Results

Top Predictors of Vaccine **Hesitancy**

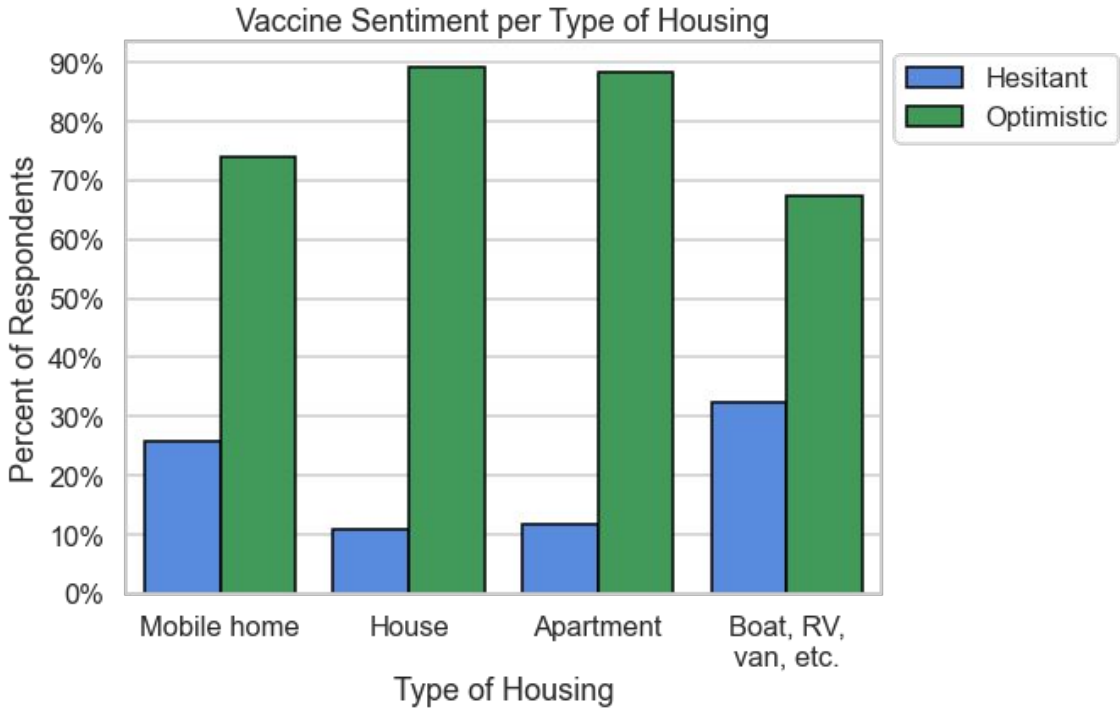
Increased odds *n* for each characteristic should be interpreted as:

"A household with this characteristic is n times more likely to be hesitant than to be optimistic"

Characteristic	Increased Odds of Hesitancy
Household residence is a boat, RV, or van	**2.48**
Greater number of individuals under 18 in the household	**2.29**
Greater level of difficulty meeting household expenses in the past 7 days	**2.24**
Greater level of household food insufficiency in the past 7 days	**1.80**
Household residence is a mobile home	**1.73**
Respondent did not use public transportation such as bus, rail, or ride-share before the pandemic, so transportation did not change	**1.51**

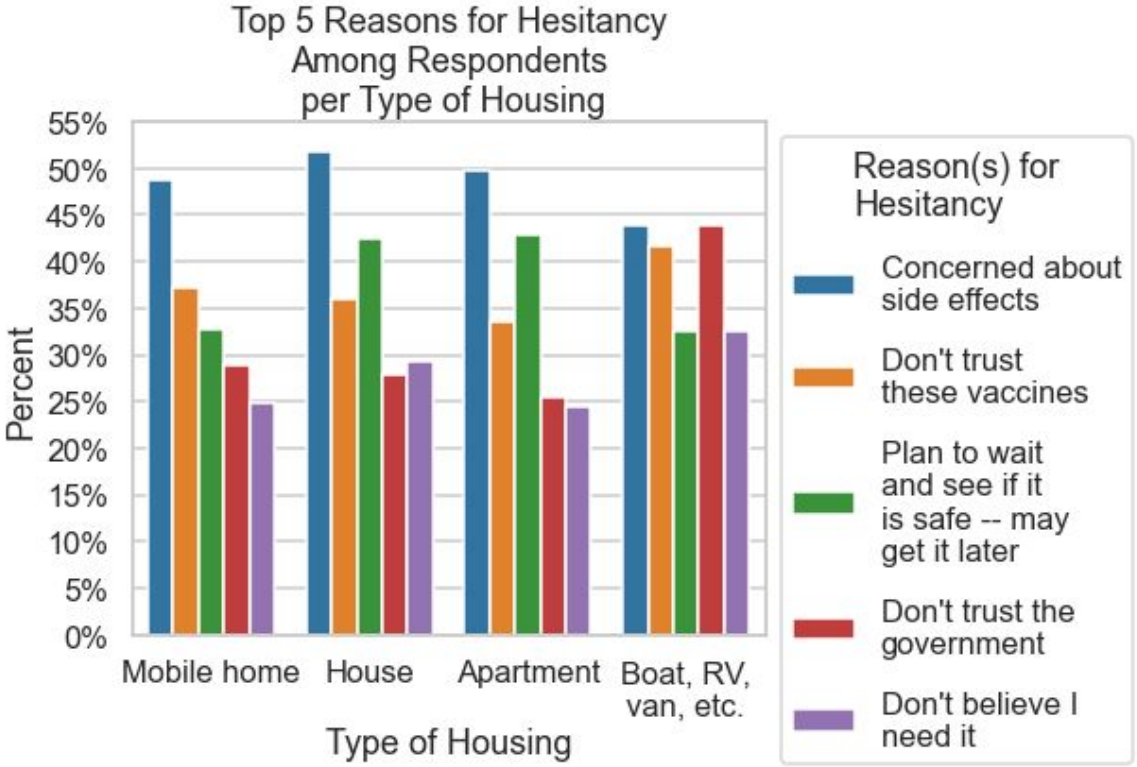
Type of Housing - Percent Hesitant

- Percentages of hesitant respondents living in mobile homes, boats, RVs and vans are more than double the hesitant percentages of respondents in houses and apartments



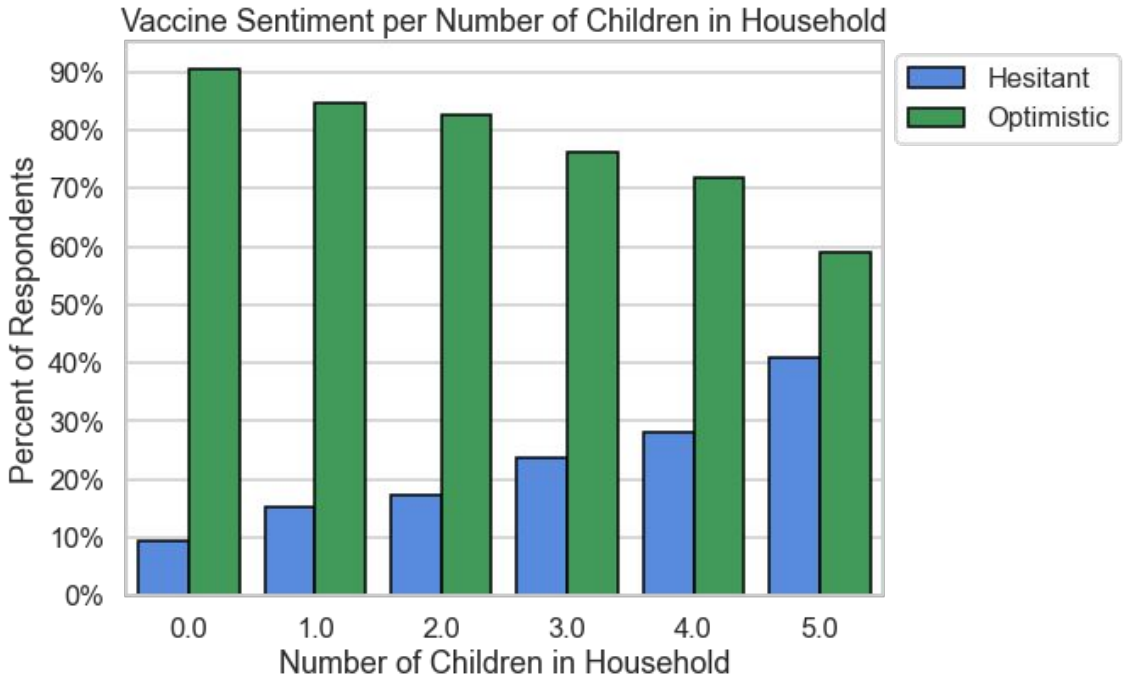
Type of Housing - Top 5 Reasons for Hesitancy

- Fewer respondents who live in mobile homes, boats, RVs or vans say they will **"wait and see"**, compared to house and apartment dwellers
- More respondents who live in boats, RVs or vans **do not trust the government or the vaccines**



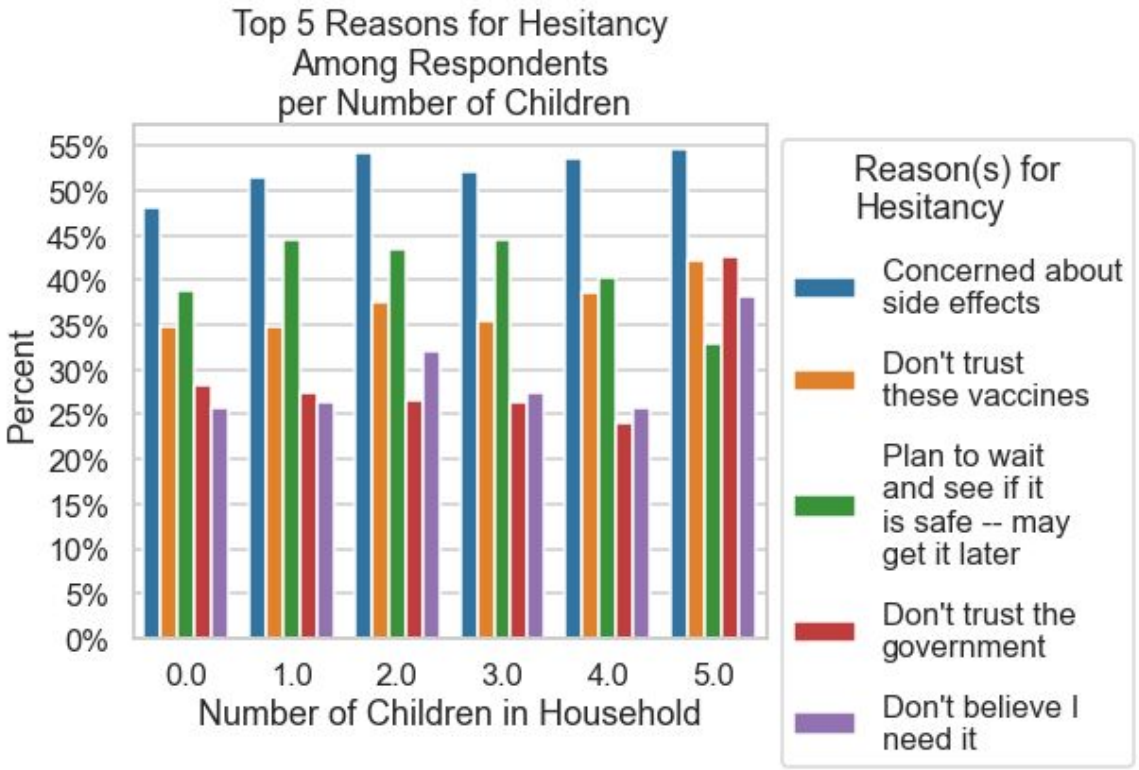
Number of Children in Household - Percent Hesitant

- The more children residing in a household, the greater the percentage of sample respondents who reported hesitancy



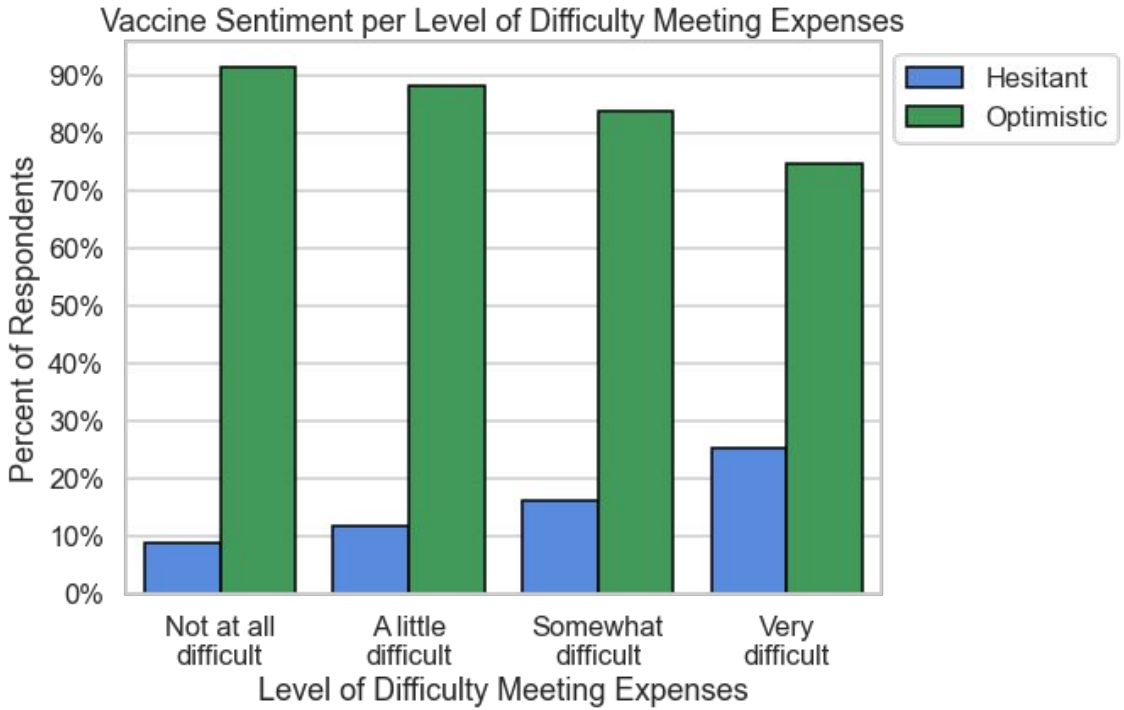
Number of Children in Household - Top 5 Reasons for Hesitancy

- Reasons are pretty similar among people with 0 to 4 children
- People with 5 children are more likely to **not trust the government** and **not believe they need it**



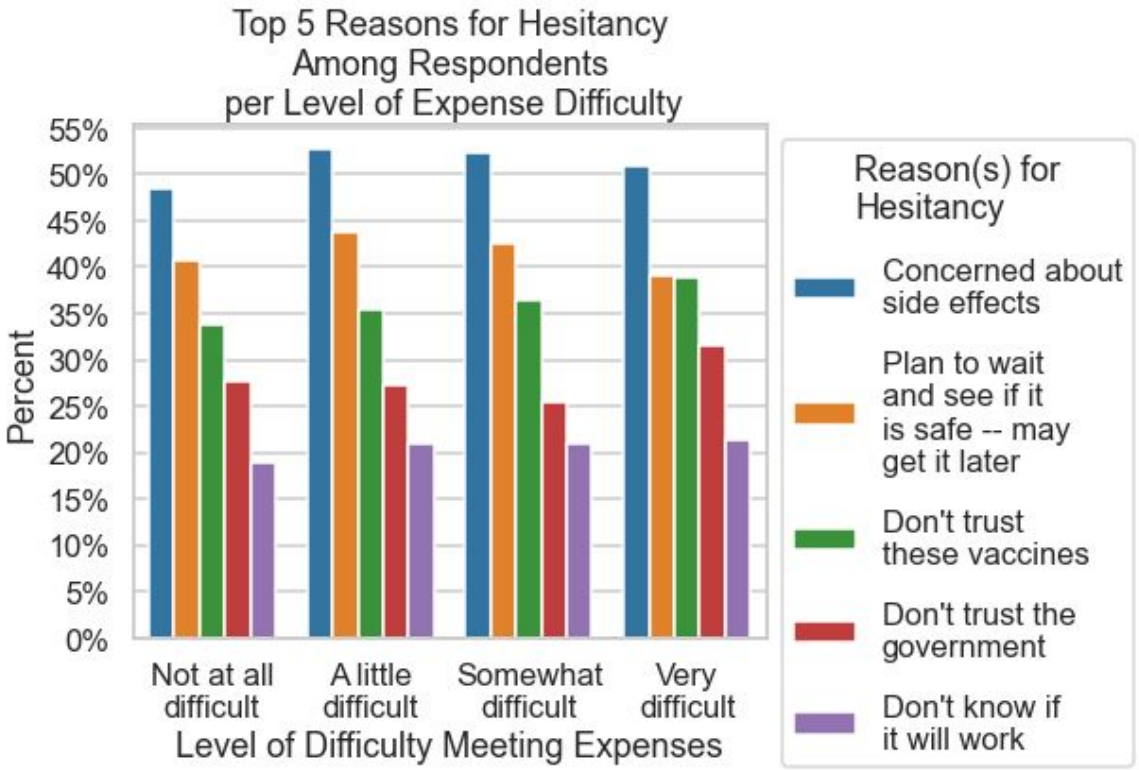
Difficulty with Expenses - Percent Hesitant

- The more difficult is has been for the household to meet expenses in the prior 7 days, the greater percentage of hesitant respondents
- More than twice as many "Very difficult" households were hesitant than "Not at all difficult", although concern about vaccine cost was one of the lowest reported reasons in the overall sample



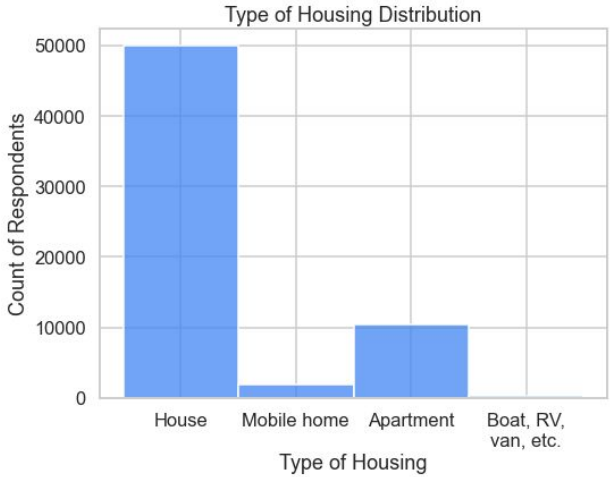
Difficulty with Expenses - Top 5 Reasons for Hesitancy

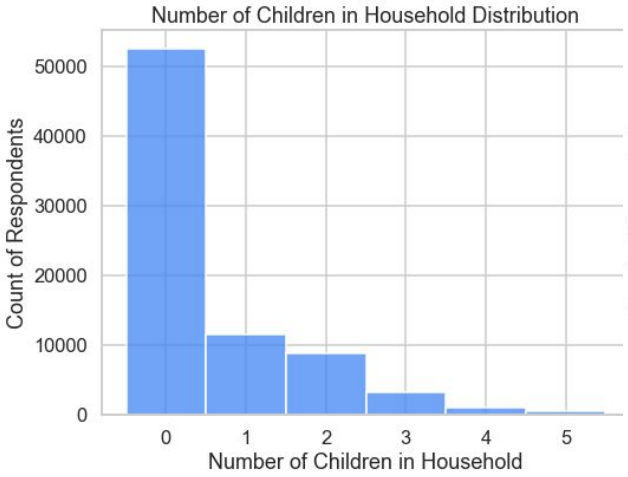
- These reasons are also pretty similar across the board
- Number 5 reason for people in the "Very difficult" subgroup is **Don't know if it will work**, which is the number 6 reason overall

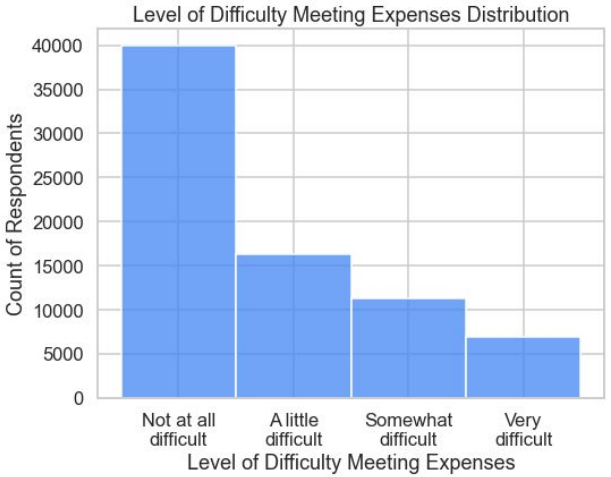


Distribution of Top Hesitancy Predictors

- The sub-groups that have the highest hesitancy percentages only make up a small proportion of the survey population







Top Predictors of Vaccine **Optimism**

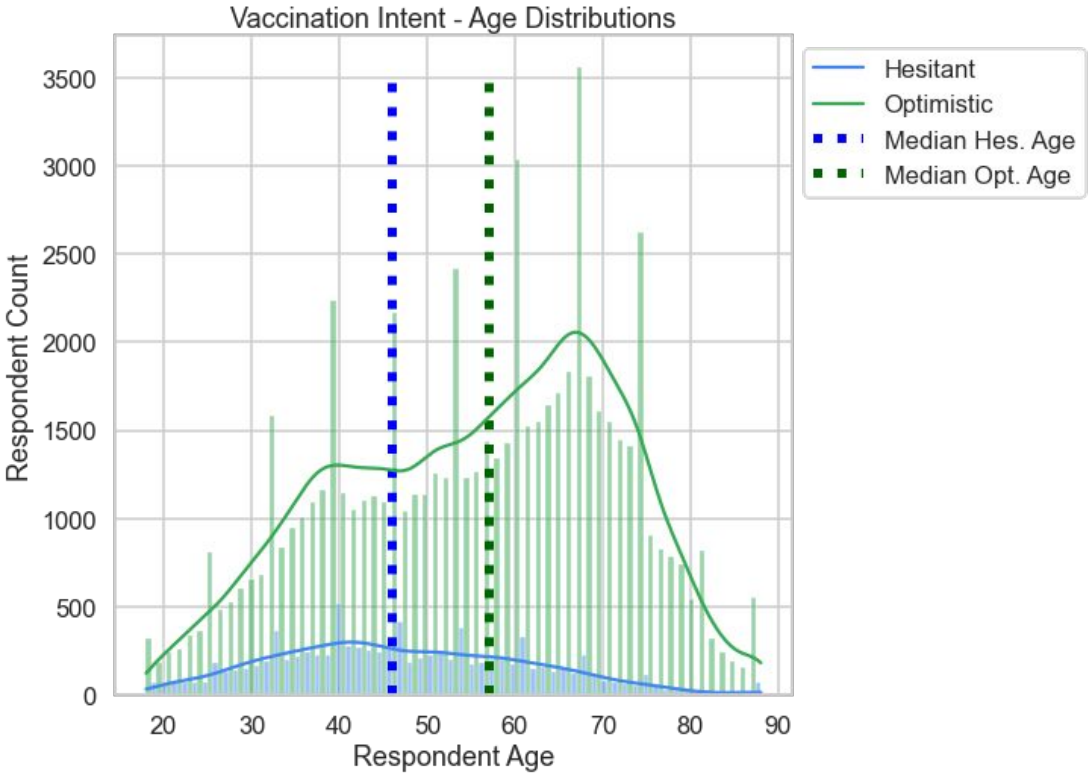
Increased odds *n* for each characteristic should be interpreted as:

"A household with this characteristic is n times more likely to be optimistic than to be hesitant"

Characteristic	Increased Odds of Optimism
Greater age in years	**6.06**
Higher level of education	**2.62**
Respondent identified as Asian versus other race	**2.22**
Members of the household had avoided eating at restaurants in the prior 7 days	**2.03**
Higher pre-tax income level	**1.89**
Members of the household had taken fewer trips to stores because of the pandemic in the prior 7 days	**1.88**
At least one adult in the household substituted some or all of their typical in-person work for telework	**1.51**

Age Distributions

- There is a statistically significant difference in mean and median ages
- The hesitant group is generally younger, with a median age of 46 compared to 57 for optimistic



Summary and Recommendations

Summary of Results

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- The top reasons for hesitancy among groups who have the highest odds of being hesitant are mostly the same as those for the whole survey sample:
  - Concerns about side effects
  - Preferring to wait and may get it later
- Sub-groups with the highest percentage of hesitant respondents were small in size, and represent a very small portion of the sample. No clear leader emerged as a primary predictor of hesitancy among the many factors which contribute.
- Being in political "red" or "blue" states or being in a metropolitan area (tends to be "blue"), were NOT high predictors of hesitancy or optimism

Recommendations

- Address the primary reasons for hesitancy across the board: concerns about side effects, and preferring to 'wait and see'
    - Collect and make public data about how likely people are to experience moderate to severe side effects
- Continue efforts that are already underway to encourage people to get vaccinated sooner by offering cash or perks
    - These efforts may help convince the 'wait and see' demographic as well as those those who said they do plan to get vaccinated but haven't done it yet
    - Perks that will appeal to younger demographics are advised