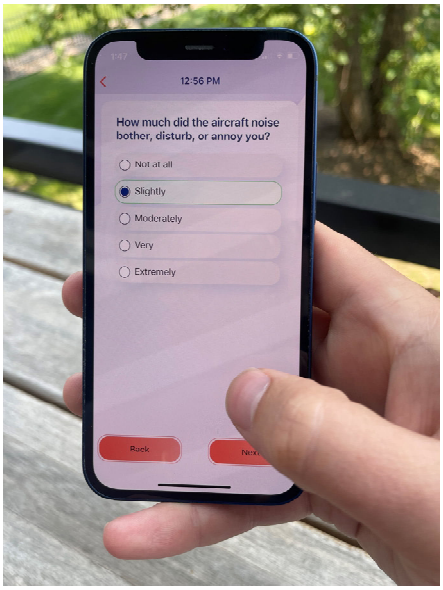
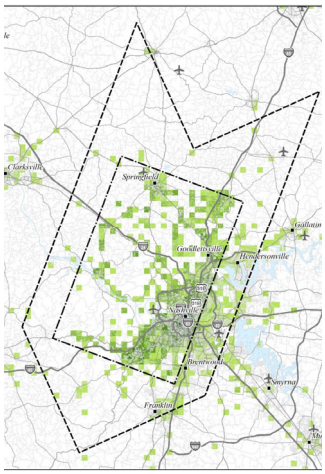
Overview of a survey methods test for the NASA Quesst community survey campaign





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In a few years, NASA is slated to begin a nationwide community survey. The goal is to understand how people respond to the sound of X-59, a one-of-a-kind experimental aircraft designed to mitigate the sonic boom during supersonic flight. The results from X-59 will generalize to any future supersonic aircraft.

This talk focuses on a survey methods test

conducted late last year.

NASA acknowledges the HMMH Contractor Team for conducting the test.

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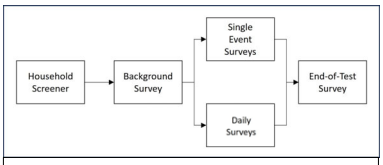
NASA selected a contractor team led by Harris Miller Miller & Hanson to plan and execute the community test campaign with X-59.

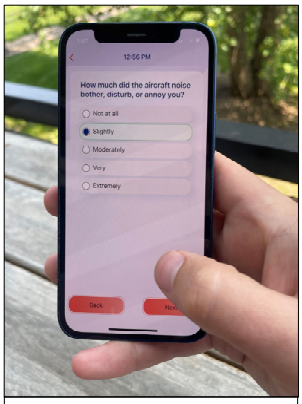
NASA acknowledges HMMH, Westat, and Envirosuite for conducting the survey methods test.

This talk summarizes outcomes and lessons learned from survey methods test.



Community Survey Structure

Key Challenges



Lessons Learned

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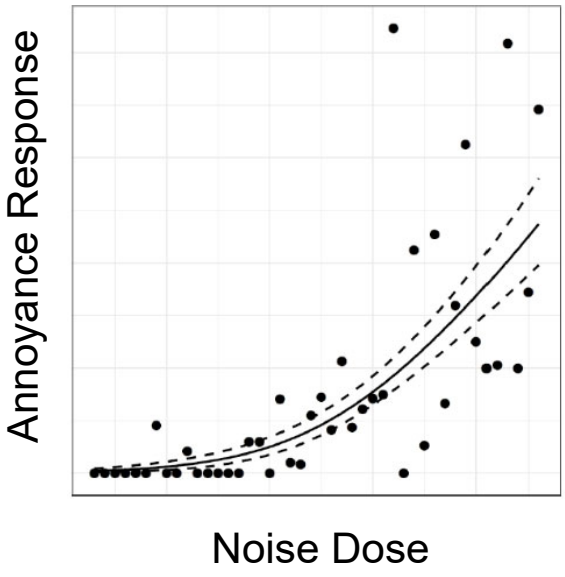
Community response data consist of noise dose and annoyance response.



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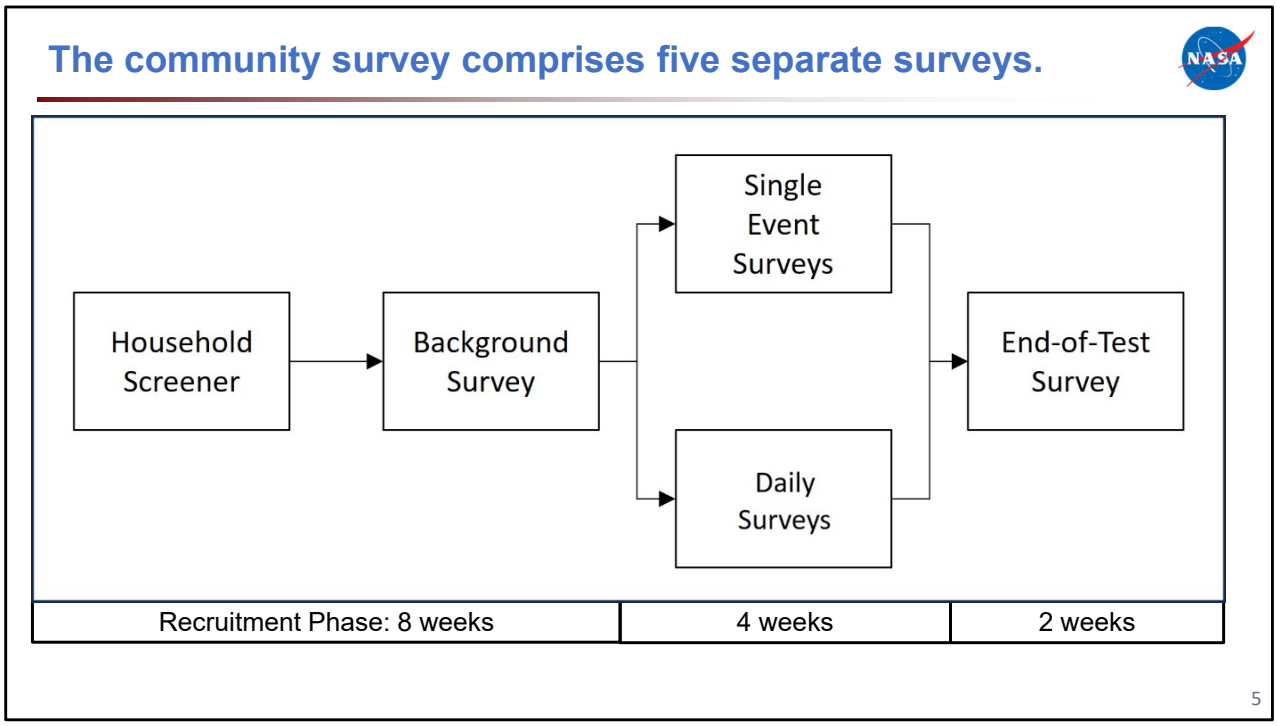
The overall goal of the Quesst community survey is to estimate the dose-response relationship shown in the plot. The sound levels from X-59 are on the horizontal axis and the annoyance levels from the survey are on the vertical axis.

For the survey methods test, there were no X-59 overflights, so the survey questions targeted commercial aircraft noise rather than X-59 overflights. No attempt was made to quantify aircraft noise exposure, and no dose-response relationship was estimated.



The community survey consisted of the 5 separate surveys shown here.

The first two surveys were conducted as part of the 8-week recruitment phase. First was the household screener targeting household recruitment. It was followed by the background survey to recruit the selected individual from the household. Individuals were considered "recruited" after completing the background survey.

Moving to the middle of the chart, the single event

surveys were conducted multiple times each day at each noise event, to mirror overflights of X-59. There were a total of 76 single event surveys throughout the four weeks. The daily surveys were conducted at the end of the day. There were a total of 23 conducted throughout the four weeks. Individuals were considered “participants” after completing at least one single event or daily survey.

The end-of-test survey assessed overall reactions and annoyance levels to the noise events during the study. Participants were given two weeks to complete it.

The community survey must overcome several key challenges.

Representative Sample

Short Timeframe

Assess Location

Maintain Participation

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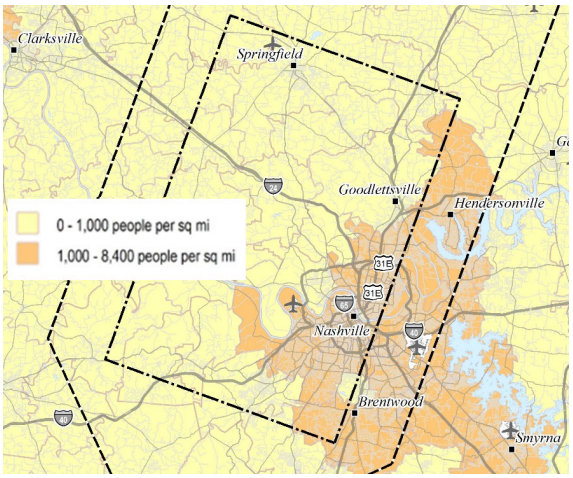
This slide shows several key challenges that needed to be overcome. These included recruiting a representative sample, conducting surveys when responses are needed in a short time frame, assessing the location of survey participants, and maintaining participation across multiple weeks.

We'll start with the top – recruiting a representative sample. Each survey sample must be representative of its locality. How do you recruit a representative sample of people from a large geographic area, many hundreds of square miles, that X-59 will overfly.

A representative sample was recruited using address-based sampling.



Mailing	Date(s) Sent (all 2023)	Quantity
Household Initial (with $2)	8/18	5,000
Household Postcard	8/25	5,000
Household FedEx	9/01	4,313
Household Final	9/08	3,992
Selected Adult Initial	9/06, 9/08, 9/15, 9/22, 9/29, 10/06	536
Selected Adult Postcard	9/15, 9/22, 9/29, 10/06	481
Selected Adult FedEx	9/22, 9/29, 10/06	429
Selected Adult Final	9/29, 10/06	234
Selected Adult Debit Card	9/29, 10/06, 10/13, 10/16	800

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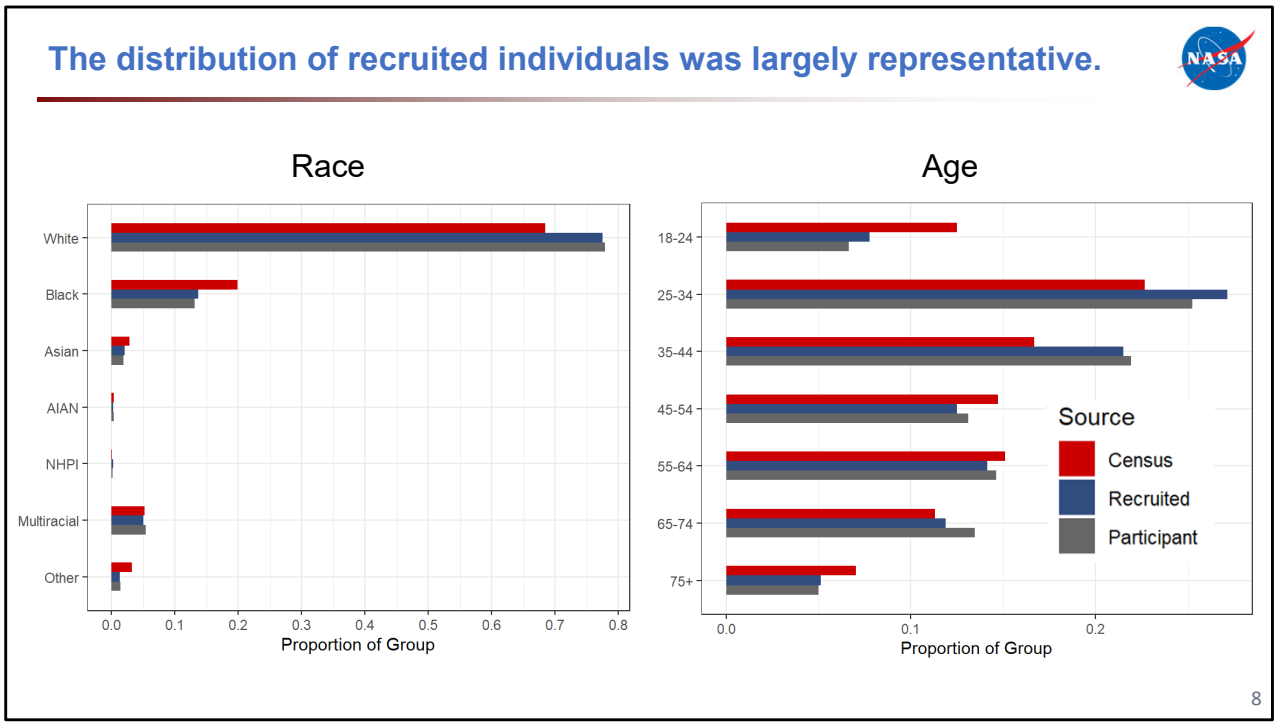
Address-based sampling was chosen to recruit a representative sample of adults in the Nashville, TN area. Nashville was chosen because it had sufficient population, mixed population densities (dense urban, suburban, and rural), typical levels of internet access, and the presence of aircraft noise.

In the map on the left, the inner box is 20 nm x 30 nm, which is the size of area that X-59 will overfly. 5000 residential addresses were selected from census blocks falling fully within the inner box. A random start was chosen and units were selected at constant intervals.

The table on the right shows the dates of different recruitment mailings over the 8 week recruitment period. The initial mailing went to 5000 addresses, and subsequent mailings went to fewer households as people were recruited. The recruitment yielded 800 people who signed up.



The results show that distribution of both recruited individuals and participants was largely representative across different demographic groups. The plots here show the distribution for race, on the left, and age, on the right. The red bars show estimates of the proportion based on Census Bureau estimates spanning 2018 – 2022. The blue bars show estimates based on the 800 recruited individuals. The gray bars show the estimates based on the 602 participants that completed at least one single event or daily survey.

While the distribution does not perfectly mirror the underlying population, the demographics are nearly the same. The distributions for other population subgroups like

education, ethnicity, and home ownership are also similar. Discrepancies like these are common in survey research. Any demographic disparities between participants and the census records will be adjusted via statistical weighting.

The community survey must overcome several key challenges.

Representative Sample

Short Timeframe

Assess Location

Maintain Participation

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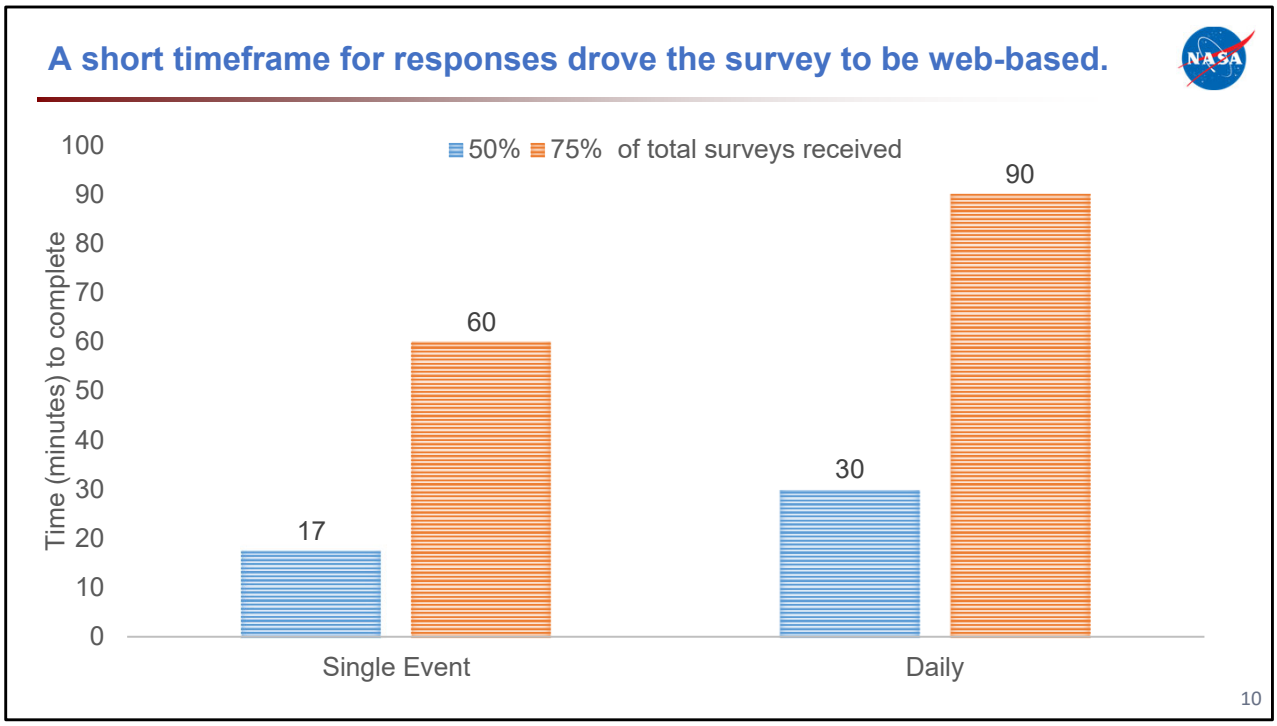
Short Timeframe: Prompt reactions are needed on the scale of minutes after an overflight. How do you assess responses soon after each overflight?



The X-59 mission is designed for up to two supersonic passes over the community before returning to base, which means only 20 – 25 minutes between the supersonic passes. To ensure that survey responses correspond to supersonic overflight noise and not other sounds, and also to the correct pass, the online surveys are opened only shortly before each simulated pass.

For the single-event surveys, the response time was relatively short, with 50% of the responses occurring within 17 minutes and 75 percent of the responses

completed within 60 minutes.

For the sake of comparison, even though there was less time sensitivity for daily surveys, the response time was somewhat longer. 50% of the responses occurred within 30 minutes, and 75 percent of the responses completed within 90 minutes.

Respondents had the choice to respond via a website or via a smartphone app. 42% of users used the app at least once.

The community survey must overcome several key challenges.

Representative Sample

Short Timeframe

Assess Location

Maintain Participation

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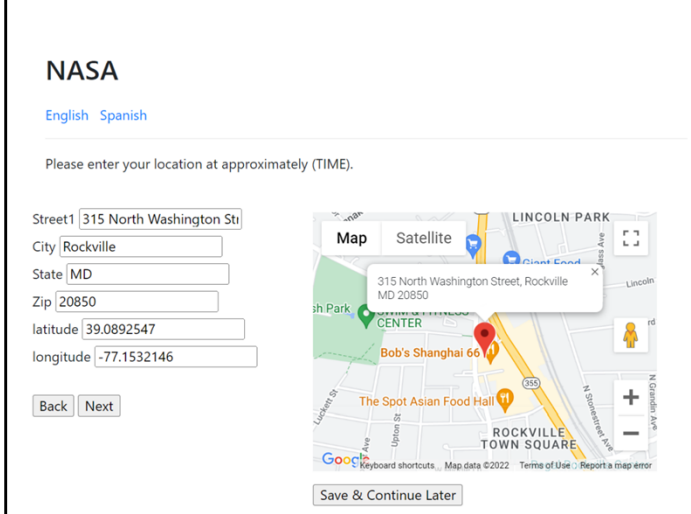
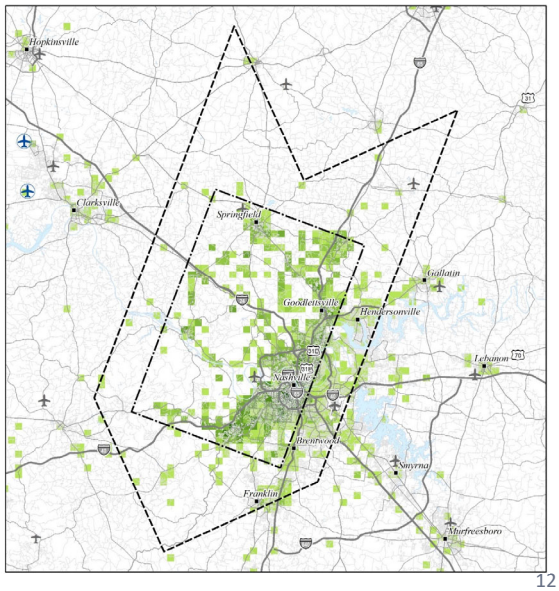
Location: In order to estimate X-59's sound level, you have to know the respondent's location. How do you collect the respondent's location during an overflight?

Survey respondents entered their location on a map.





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Survey respondents were directed to enter their location at the time of the overflight, as shown on the left. They were given the option of choosing prepopulated locations of home and work, or of inserting a street address or intersection, or dropping a pin on a map.

If they couldn't respond at the time of the survey, they were allowed to do so until the end of the day.

The plot on the right shows the density of respondent locations for all surveys on all days. The majority of

locations are within the inner box, but some locations are clearly outside the X-59 sound zone.

The community survey must overcome several key challenges.

Representative Sample

Short Timeframe

Assess Location

Maintain Participation

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Participation: To allow time for a community to get used to a new sound, the survey will last multiple weeks. How do you maintain respondents' participation for ~4 weeks of supersonic overflights?

A graduated survey incentive scheme was tested to maintain survey participation across 4 weeks.

Week or Item	0-49% Complete	50-74% Complete	75-99% Complete	100% Complete
Background Survey	$0	$0	$0	$10
Week 1 SE and DS surveys	$0	$25	$35	$45
Week 2 SE and DS surveys	$0	$30	$40	$50
Week 3 SE and DS surveys	$0	$35	$45	$55
Week 4 SE and DS surveys	$0	$40	$50	$60
EOT survey	$0	$20	$20	$20
Grand Total Earned Incentive Potential per Participant				$240

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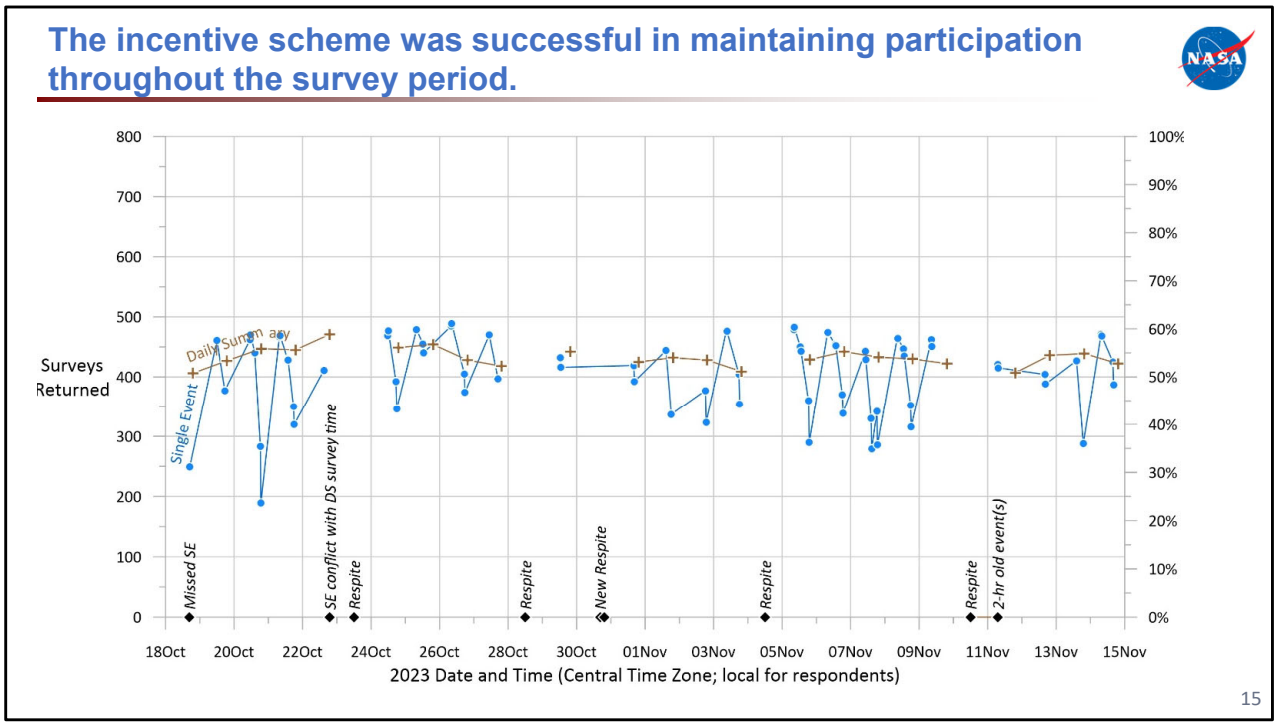
A scheme of graduated survey incentives was developed to maintain participation across the four-week study. Each week respondents earned an incentive based on their level of survey completion. The incentive increased by $5 each subsequent week. A participant who completed 100% of all surveys could earn a maximum of $240.



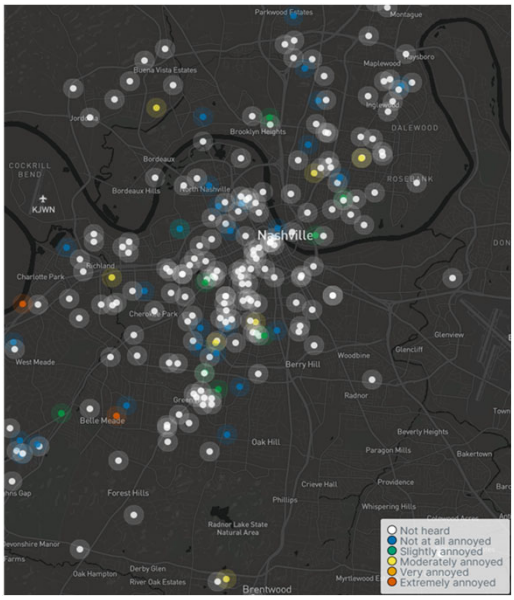
The incentive scheme was successful in maintaining participation throughout the survey period.

As shown in the plot, the single event survey response in blue was consistently between 40 and 60%. The daily survey in red was consistently above 50%.

An interesting detail is that single-event surveys toward the end of the day tended to have lower response rates than earlier in the day. This was probably due to less time available to respond to the surveys before the survey closed at the end of the day.

Not shown on this plot, but 67% of end-of-test surveys were returned.

A user interface displayed survey responses as they were received.



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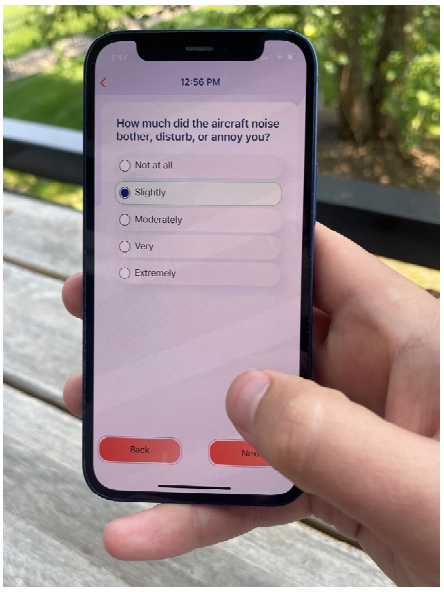
For situational awareness, a user interface was developed to report single-event survey responses in near real time, geolocated on a map. The legend shows that warmer colors indicate more severe annoyance responses.

The lessons learned will improve Quesst community survey.



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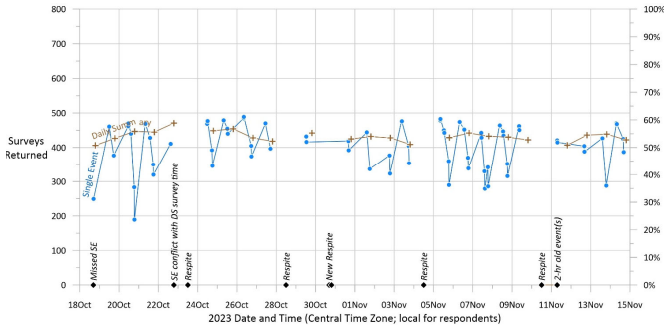
1) Survey Operations
   a. The response rate to the first single event survey was lower because respondents had issues accessing the survey system again weeks or months after accessing it. The contractor team recommends a self-service option for resetting passwords. The contractor team also recommended better visibility for the FAQ in the mailings to survey and emphasizing to respondents to keep their incentive debit cards until after the end-of-test survey.

2) Survey Content
    a. The contractor team recommends that respondents confirm their current residence matches the address on the invitation letter. Mitigate some issues that were observed when participants do not live at the sampled address.
3) Systems
    a. Importance of automation in critical processes. The process for opening single-event surveys was manual and a few surveys were missed for various reasons.
    b. Vulnerability of systems to network and server problems → Critical role of backup systems and personnel for operational integrity
4) Survey User Interface
    a. There were challenges in both developing requirements for survey user interface as well as accurately estimating time needed for software testing and integration. NASA has brought a systems engineer onto the team to help develop and track system requirements.
    b. Confusion associated with UTC and crossing days.

In conclusion, the Quesst community survey system functioned well and is ready for integration with the other data collection systems.



Quesstions?
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Sampling method enabled **a representative sample** of 602 participants.

Incentive scheme maintained participation over multiple weeks.

Participant locations were assessed.

Survey responses were **collected on the order of minutes or hours** after surveys opened.