California MPO Household Travel Survey Design

SCAG Modeling Task Force Meeting

January 25, 2017

Overview

Joint survey design with MTC, SCAG, SACOG and SANDAG (MPO Partners)

- – MTC is contracting agency
- – Project has been awarded but not contracted

3 Phase Program

1. Cooperative survey development
2. Ongoing maintenance of survey infrastructure, methodology testing, and refinements
3. Travel survey data collection

Overall Approach

Highlights of Approach

- Novel work for household data collection
- Demonstration of smartphone application
- Improving survey participation
- Providing survey materials
- Targeting hard-to-reach populations

Innovations for travel data collection

Embrace new technologies to retain strengths of existing methods that drive down cost and drive up data quality.

Stated Preference Surveys

- 1986 RSG leads used of SP for tolling and new modes

On-line Surveys

- 1995 RSG pioneers on-line surveys, builds rSurvey

Smartphone Surveys

- 2010 RSG builds rMove, adding features through extensive testing
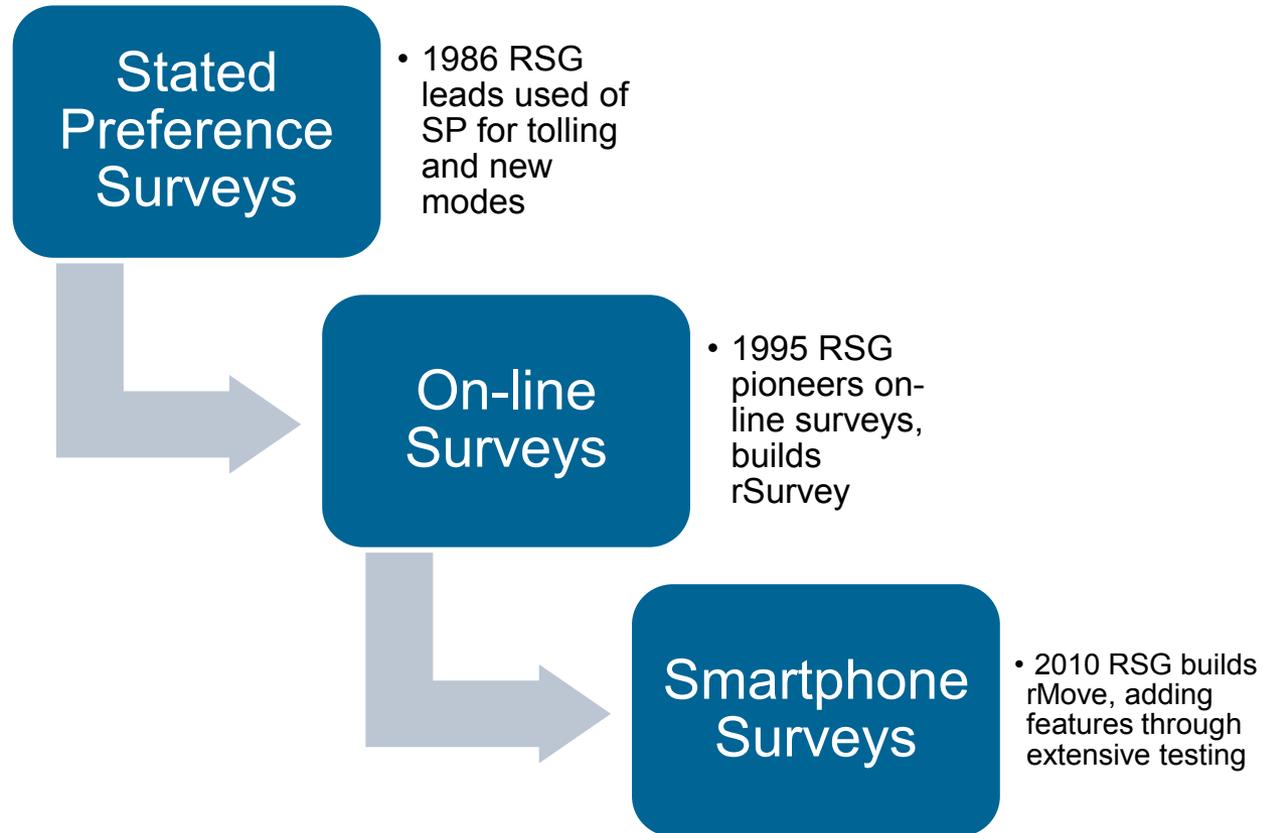
rMove
A Smartphone Application for Travel Surveys

- Support Website

- Android
 Store Listing

- Apple
  Store Listing
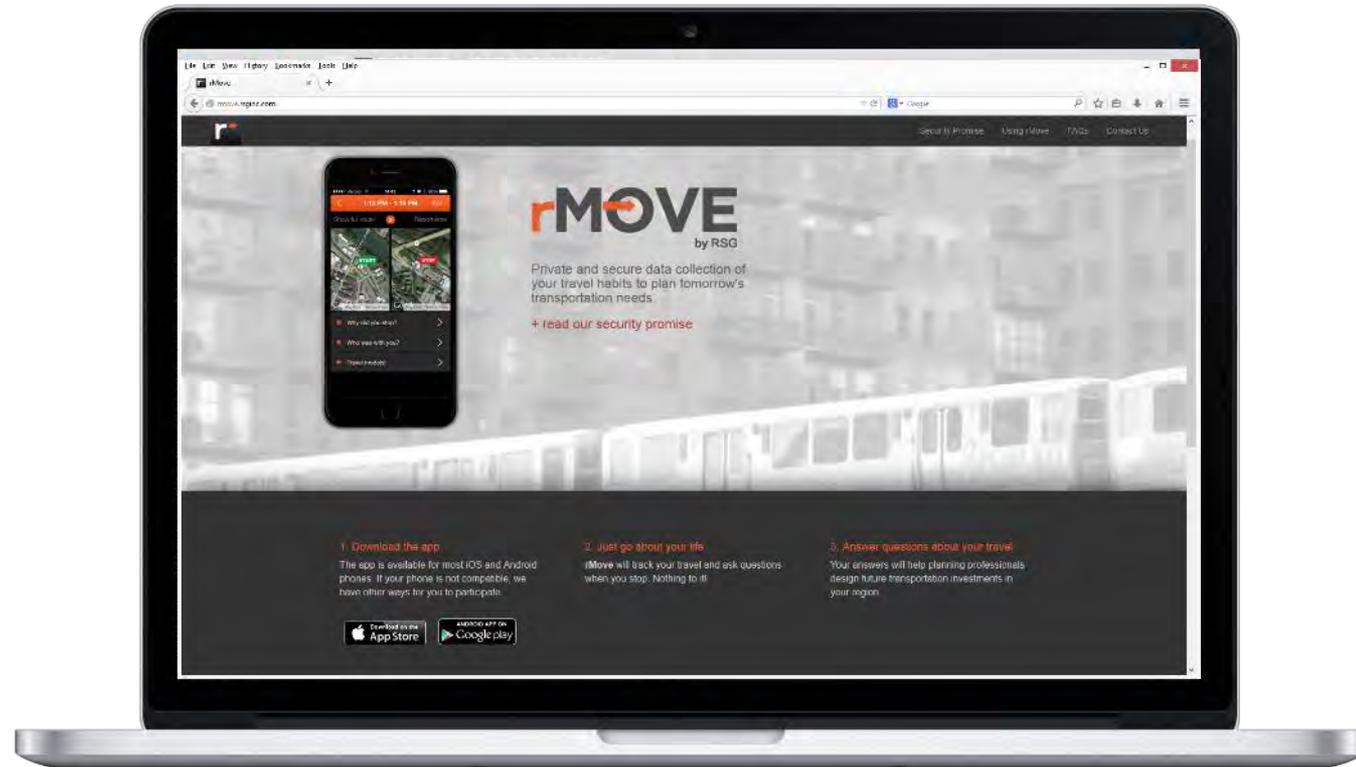
The Basics

- Automatically runs in background & on device power-up

- Multiple smartphone sensor utilization (GPS, compass, WiFi)

- Adaptive GPS collection technology to optimize battery life

- Automatic recording of trip path & duration

- Automatic trip start & end/stop detection

**HOME SCREEN**
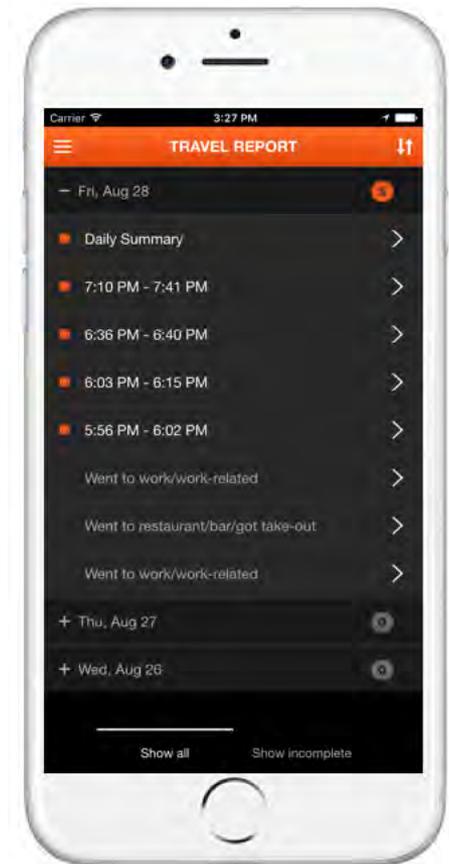
How Does it Work?
Steps for Respondents

1. Notification of in-app trip survey, triggered after stop

2. Validation of trip start and end

3. Selection of which vehicle used and persons in HH on trip

4. Ability to give feedback, report errors and
   – Split trips
   – Merge trips
   – Add trips

5. Confirmation of any repeat trips that are matched
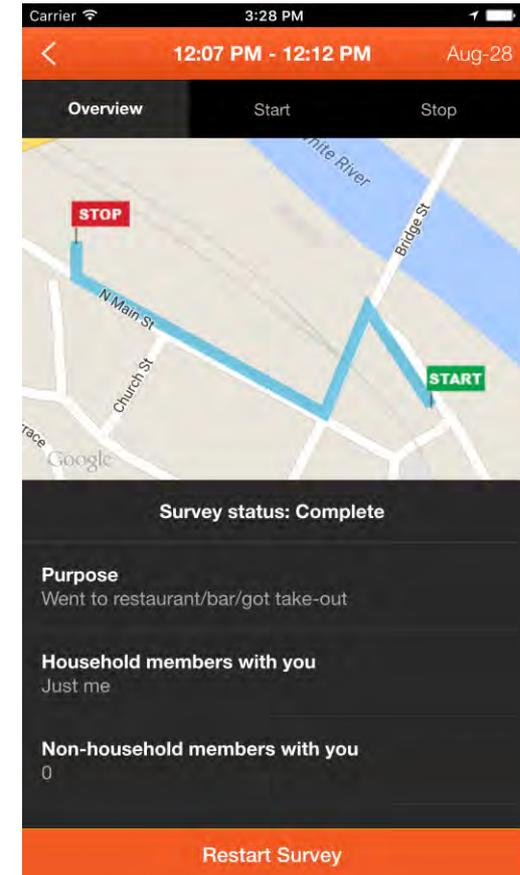
Automatic Data Transfer & Communications Reduces Cost

- Automatically encrypted transfer of data to server immediately after each trip is complete (assuming connection)

- Automatic monitoring of hardware: Reminders if GPS/WiFi turned off

- In-app messages indicating start and end of assigned data collection period
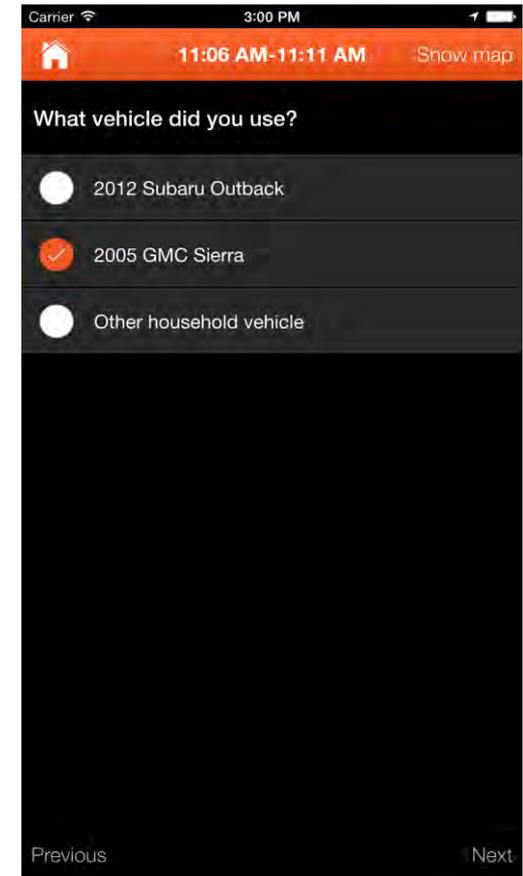
Timely Prompted Recall
Improves Data Quality

Madison County 7-day Survey

17% of trip surveys answered within 10 minutes of travel

Hours between Trip End & Trip Survey Completion

- 1 hour or less: 40%
- 1 to 2 hours: 13%
- 2 to 5 hours: 18%
- 5 to 12 hours: 13%
- 12+ hours: 16%

Trip Ends & Survey Completions by Hour of Day

- Time Trip Ended
- Time Survey Completed
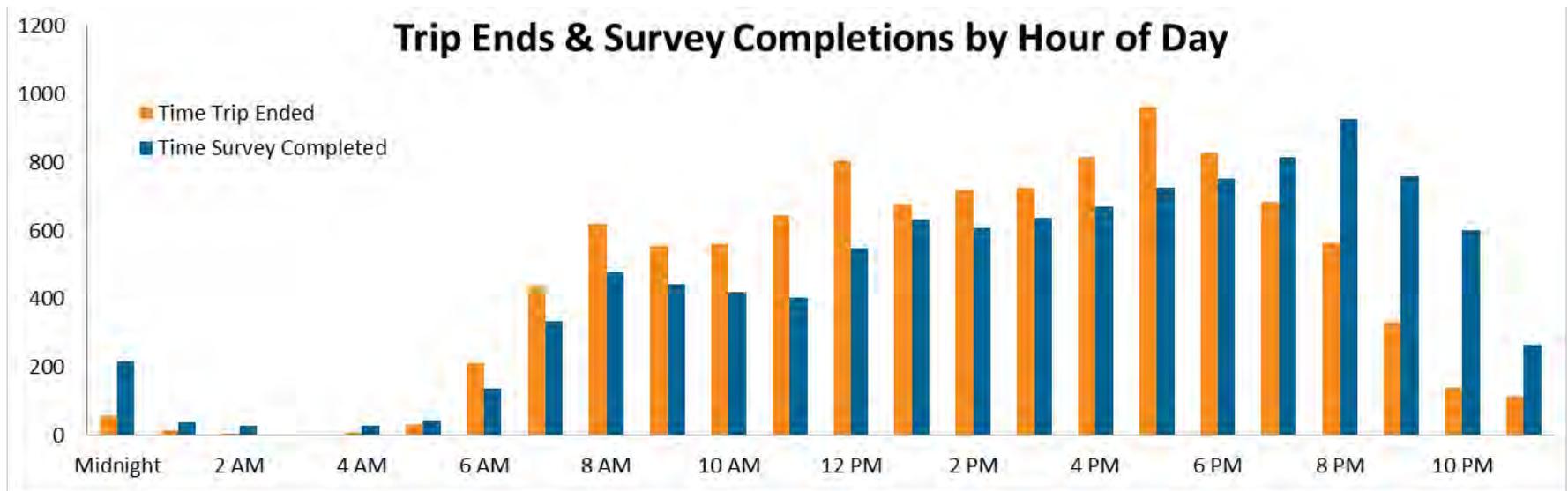
Accurate Trip Recording
Reduces Under-reporting

- Fewer no-travel person-days

- More 10+ trip person-days

- Higher trip rates overall

Distribution of Weekday Trips


Trip Rates by Person Day

Improving Data Quality
Reduces Non-Response Bias

By Age

Trip Rates by Age and Income in Seattle

Higher and more stable trip rates among young adults and higher income adults
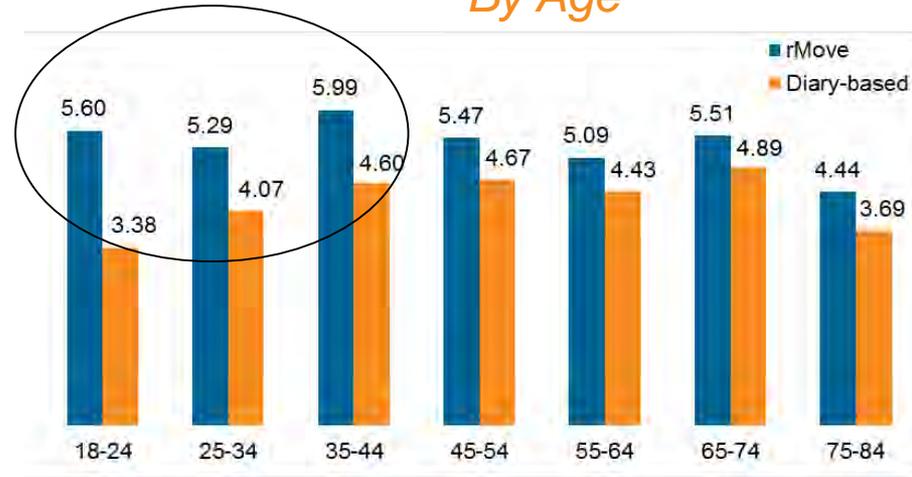
By Income
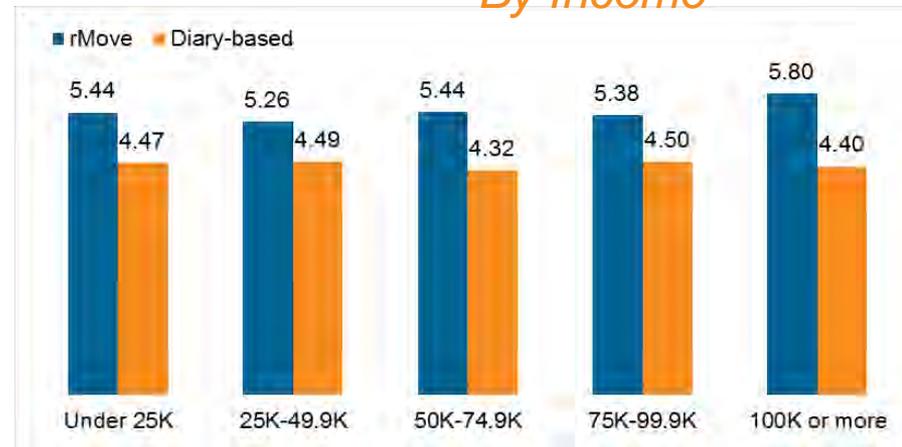
Households without Smartphones
Cost Tradeoffs

- – Smartphone ownership increasing, but still 68% of US adults
  - • Most non-owners are older adults, low-income adults
- – Lending smartphones to non-owners is expensive (similar to GPS devices)
  - • And users may not be tech-savvy (need more support - Ohio pilot data…)
- – Recommend…supplement rMove surveys with on-line or phone surveys for children and non-smartphone owners
  - • The rMove and diary-based data are compatible and can be used jointly in modeling

Focus on Media of Choice

- • Providing smartphones less cost-effective
- • On-line or phone offered instead

Multi-day Data
More Data Across Segments

- Better coverage of origin/destination patterns

- More data on rarer modes (transit, walk, bike) which people often use only on certain days

- More data on day & time-specific travel
  - Saturday and Sunday travel patterns
  - Weekly travel patterns, substitution of activities across days
  - Day-to-day variability in peoples' behavior
  - Travel patterns by time period, effects of congestion
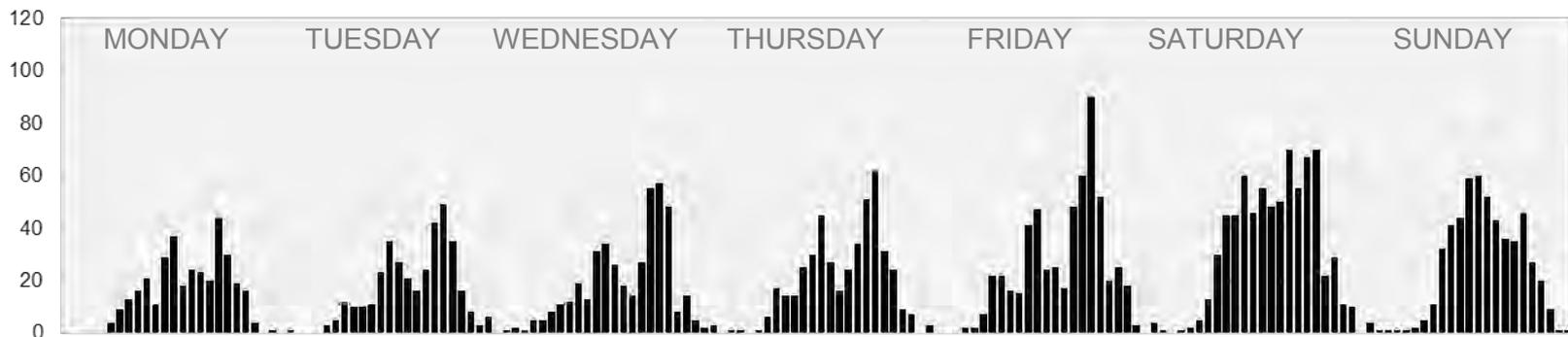
Ohio Leisure/Entertainment Trips By Hour & Day of Week

Supplemental Survey Materials

Websites
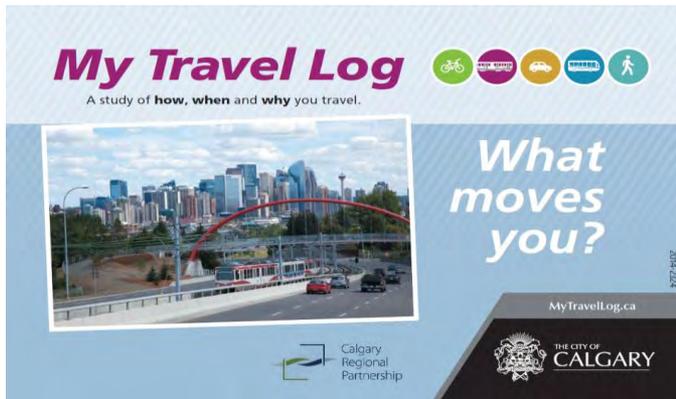
Website,
Postcards,
Letters

Successful Surveys

It's not just about the smartphone app!

MANAGEMENT

1. Project
2. Communication
3. Scope
4. Cost
5. Schedule
6. Change
7. Quality
8. Risk
9. Deliverables

DESIGN AND ADMINISTRATION

- Sample Frame and Methods
- Convenience Samples
- Cloud Servers
- Quality Control
- Data Monitoring
- Weighting and Expansion
- Data Cleaning and Processing

Reducing Respondent Burden

All-in-One Travel Diary Experience
Reduces Respondent Burden

- Provide complete trip data using the same device

- People have phones with them: rarely forget them or leave in the car

- People often check phones: e.g. answer questions while waiting in a line

- Validating and correcting trips on the same device
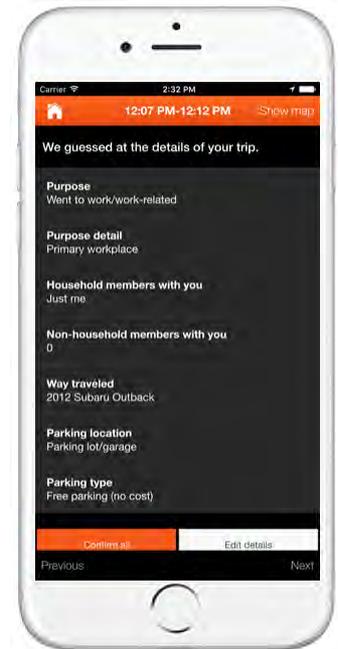
Burden Reduction Leads to Better Data

Why does this matter?

- Decreasing response rates
  - Recall and non-response biases

Features that reduce burden

- Built in "help" features & prompts/alerts
- Automatic behavior in background
- Automated customization/validation
- In-app ability to edit/add trips
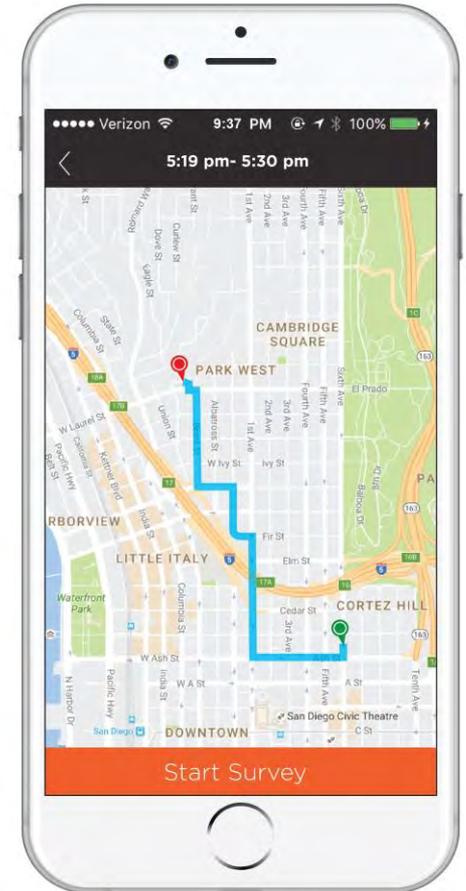
Intelligence (also) Leads to Better Data

Trip Matching Reduces Burden

- Repeat trips matched to reduce respondent burden
  - Example: Same home to work commute
- Answers from matched trips are pre-populated so users can accept or change details for the trip
- 26% of trip matches are revised

Avoids Data Inconsistencies

- 74% of trip matches are correct
- Continuing to improve trip matching
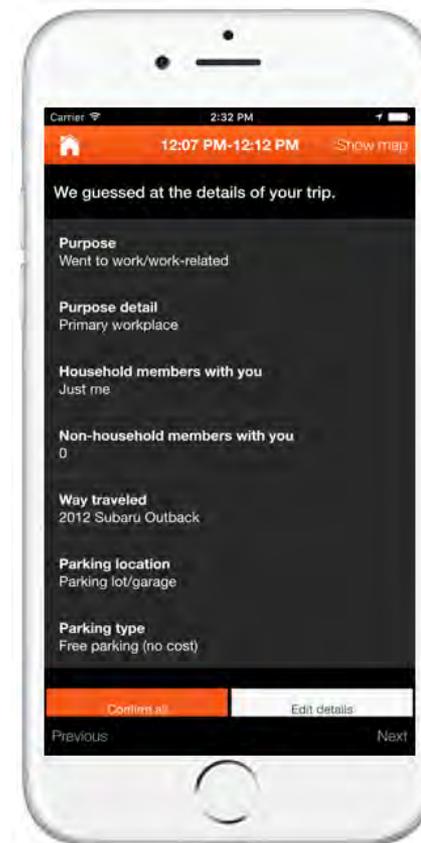
Future Improvements

Further drive down burden & improve intelligence

- Extend all-in-one experience
- Extend behavioral "nudging" of participants
- More intelligence based on previous trips and reported habitual points of interest
- More machine learning for data cleaning/processing
- Leverage smartphone improvements (new sensors, better battery life, etc.)

Economies of Scale and Optional Features

Economies of scale related to *standardization*

- Questionnaire design
- Questionnaire software programming
- Sampling approaches and data processing
- Outreach recommendations and examples
- Translation of materials to new languages
- Joint pre-testing across multiple regions
- Survey data formats and processing, including QA/QC

Economies of scale related to *improvements*

- "Compensatory oversampling" anticipates non-response bias and accommodates in advance

- "Targeted oversampling" obtains data more efficiently for rare and hard-to-reach segments

- Smartphone-based approach provides multiple travel days and more trips per day, as well as new types of spatial and temporal data (route choice, walk and wait times, etc.)

Accommodations to maintain *agency flexibility*

- Agencies add own set of questions in addition to the core standard questions.

- Agencies set own parameters for sampling—which groups to oversample and to what extent.

- Agencies devise own outreach priorities and strategies using local knowledge and outreach firms.

What are the required core components?

- A sampling plan setting invitation rates by Census block group, with appropriate oversampling

- A recruitment survey, administered by internet or telephone (including smartphone)

- Collection of one or more days of travel data using a mobile app for smartphone owners and internet or telephone retrieval for others.

- Data processing, cleaning and QA/QC

What could be optional?

- Pre-tests in Phase 2 and 3
  - Only as needed to test changes in survey design
- Translating materials into more languages
- Supplemental survey components/markets
  - Long distance survey
  - Visitor survey
  - University student survey (incl. group quarters)
  - Military base survey (incl. group quarters)
  - Special generator surveys (airports, malls, etc.)
  - Attitudinal and stated preference questions
  - Convenience samples for new behaviors

Strategies for Hard-to-Reach Households

RSG will use a multilayered approach to ensure the study is __accessible__ and __engaging__ from end to end

Targeted Sampling

Use geographic oversampling to sent **more invitations** to oversample hard-to-reach populations.

Targeted Outreach & Communication

--Multi-language translations and help facilities/websites

--Regionally-specific recruit material to increase engagement

--Additional calls or emails to certain participants

--In-person outreach to local communities

Targeted Incentives

--Proposed incentive design helps target larger HHs

--Incentive design can be targeted several ways. Possible to "delay" differential incentives until the need is evident.

Studies have to overcome many barriers to participation, which are often interrelated

Language

Time/Value

Technology

Trust & Privacy

Complexity

Other barriers
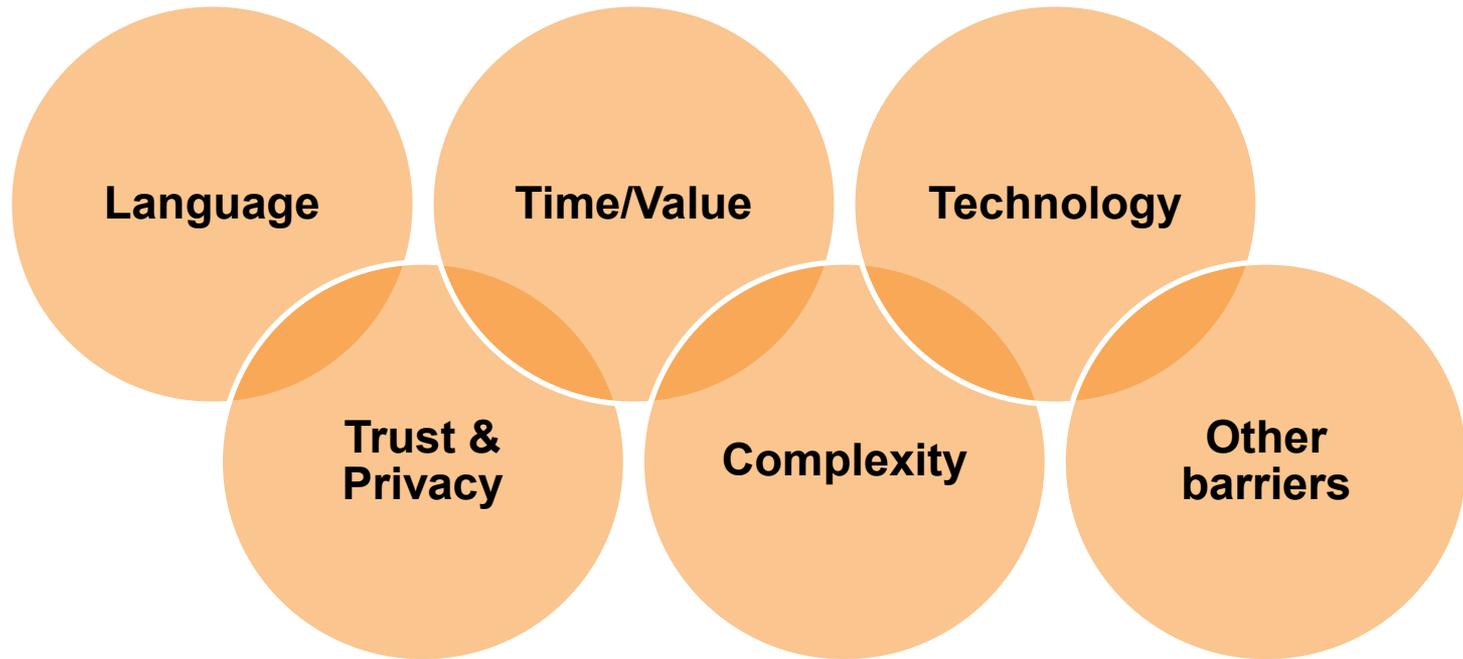
Who is hard to reach? Language examples

Households by Household Language

Geography	Total HHs	% English	% Spanish and not English	% Other and Not English	% of HHs Speaking English or Spanish
State of California	**12,617,280**	**90.4%**	**5.6%**	**4.1%**	**95.9%**
Los Angeles County	3,242,391	86.0%	8.1%	5.9%	*94.1%*
San Diego County	1,083,811	92.2%	4.8%	3.0%	*97.0%*
Orange County	1,002,285	90.6%	4.3%	5.2%	*94.8%*
Riverside County	690,388	93.2%	5.4%	1.4%	*98.6%*
Santa Clara County	614,714	88.7%	3.3%	8.0%	*92.0%*
Sacramento County	519,460	93.1%	2.5%	4.3%	*95.7%*
San Francisco County	348,832	87.5%	2.2%	10.4%	*89.6%*

Languages currently available

Study item	Languages Currently Available	% of total translation effort (est.)**
rMove	English, Spanish	25%
Online Recruit Survey	English + Google Translate	25%
Online Travel Diary	English + Google Translate	15%
Mail materials	English, Spanish	25%
All Other Comm. (e.g. emails, calls)	English, Spanish	10%

*Assumes the project would reuse material from the SANDAG HTS.
** "Total translation effort" implies translating all study material and printing/mailing a letter.

Emerging Trends in Travel Behavior

View of the Future

- **Exciting times**
  - Datasets have revolutionized fields: Framingham Heart (medicine), Nielsen (media), Knowledge Networks (social science),…
  - Time for a revolution in transportation. Let's lead in California.

- **Future Key #1: Blending data**
  - Household travel diaries will always play a role
  - Move beyond smartphone as conduit for gathering traditional information
  - Call data records
  - Social Media
  - Real-time transport level of service and land use databases

- **Future Key #2: Blending methods**
  - Econometrics will always play a role
  - Machine learning/CS

- **Future Key #3: Diving deep in dynamics and continuous data collection**
  - Facing key trends now
  - Habit formation and lifestyle choices critical
  - Access behavioral responses to naturalistic and planned experiments

Leveraging "Big data" Resources

- **Passive location data
  (AirSage, Streetlight, Inrix, etc.)**
  - OD flows for survey expansion and model calibration

- **User transactions data
  (transit smartcards, toll transponders, bikeshare usage, etc.)**
  - Flow and cost data of specific modes for survey expansion and model calibration

- **Non-Census socio-demographic data
  (retail transactions data (Eclipse, Experion, etc.)**
  - Useful for targeted sampling and weighting

- **Social media (Facebook, Twitter; Craigslist; Yelp, etc.)**
  - Useful for convenience sampling and recruitment
  - Useful for data mining and outreach

Emerging Changes in Travel Behavior

- **Usage of new types of vehicles (plug-in Evs, future Avs, etc.)**
  - Convenience sampling via DMV data (e.g. CEC Vehicle Survey)

- **Usage of new sharing systems (CarToGo, Zipcar, Lyft, Uber, bike share, many new types that will arise)**
  - Convenience sampling via systems sending out survey invites to their users. (Have done this for paratransit and vanpool systems.)

- **New preferences of Millennials and next generation**
  - Can add targeted attitudinal and preference questions. (Have done this for a number of recent TRB studies.)

- **Others that we don't know about yet…**
  - Leave flexibility for adding new types of questions.

Survey Methods to Efficiently Measure Changes

Sweet Spot

For Cost Savings & Current Data

Infrequent
Cross-Sectional

Truly Continuous

Design Decisions

- Frequency of Data Collection
- Mix of cross-sectional & panel sample
- Supplemental Surveys
- Mix of technologies
- Mix of geographies

Example Projects

- State of Ohio
- PSRC (Seattle)
- State of Utah

Summary

Summary

- Integrate survey and travel demand modeling needs in survey design

- Set sample size and schedule expectations

- Use innovative technologies & methodologies that have been tested elsewhere

- Pragmatically embrace change as means to increase data quality and decrease costs

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