Leveraging the Mobile Cloud for Travel Demand

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The Data Deluge

- Web browsing history
- GPS
- Accelerometer
- Phone call and message history
- WiFi and cell towers
- Social networks
- Environmental sensors
- Calendars
- App usage
- Bluetooth: Interactions with people
- External body sensors

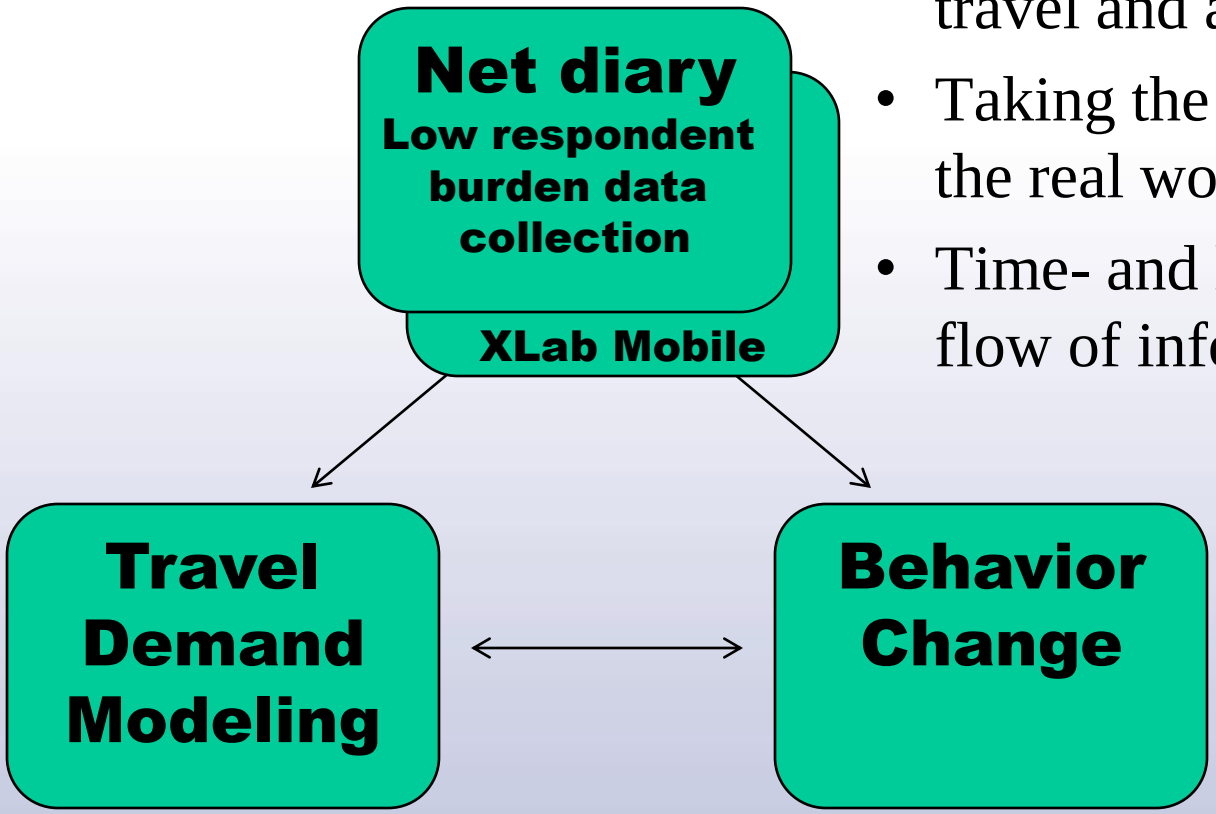
Transportation System
Transit routes (GTFS), Next bus, Real time 511, Google, Waze

Activity system
Parcels, Yelp

Sentiment
Tweets

Research Agenda

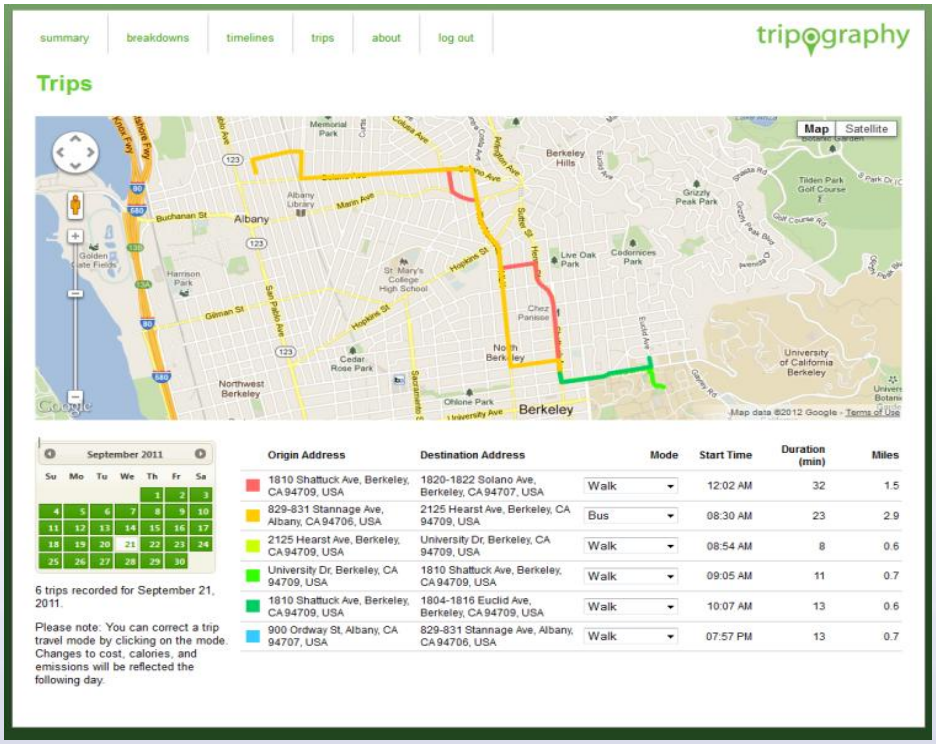
- Innocuous collection of travel and activity data
- Taking the lab into the real world
- Time- and location-specific flow of information



Low respondent burden data collection

Net Diary

- Infer
  - Activity locations
  - Timing
  - Mode
  - (Purpose, Carpool)
- Components
  - Smartphone-based
  - No/low data entry
  - Minimal use of battery



The Quantified Traveler System

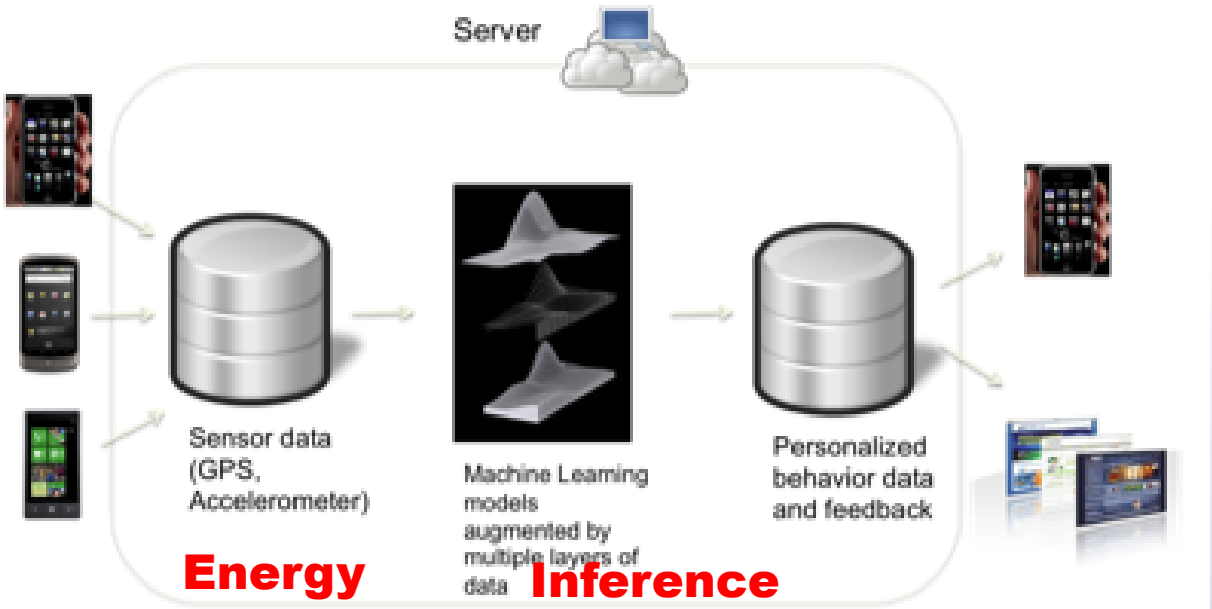


Figure 2: System Architecture and Flow of Data

- Energy consumption very important for longer surveys
- Majority of users actively manage apps to improve battery life

Low respondent burden data collection

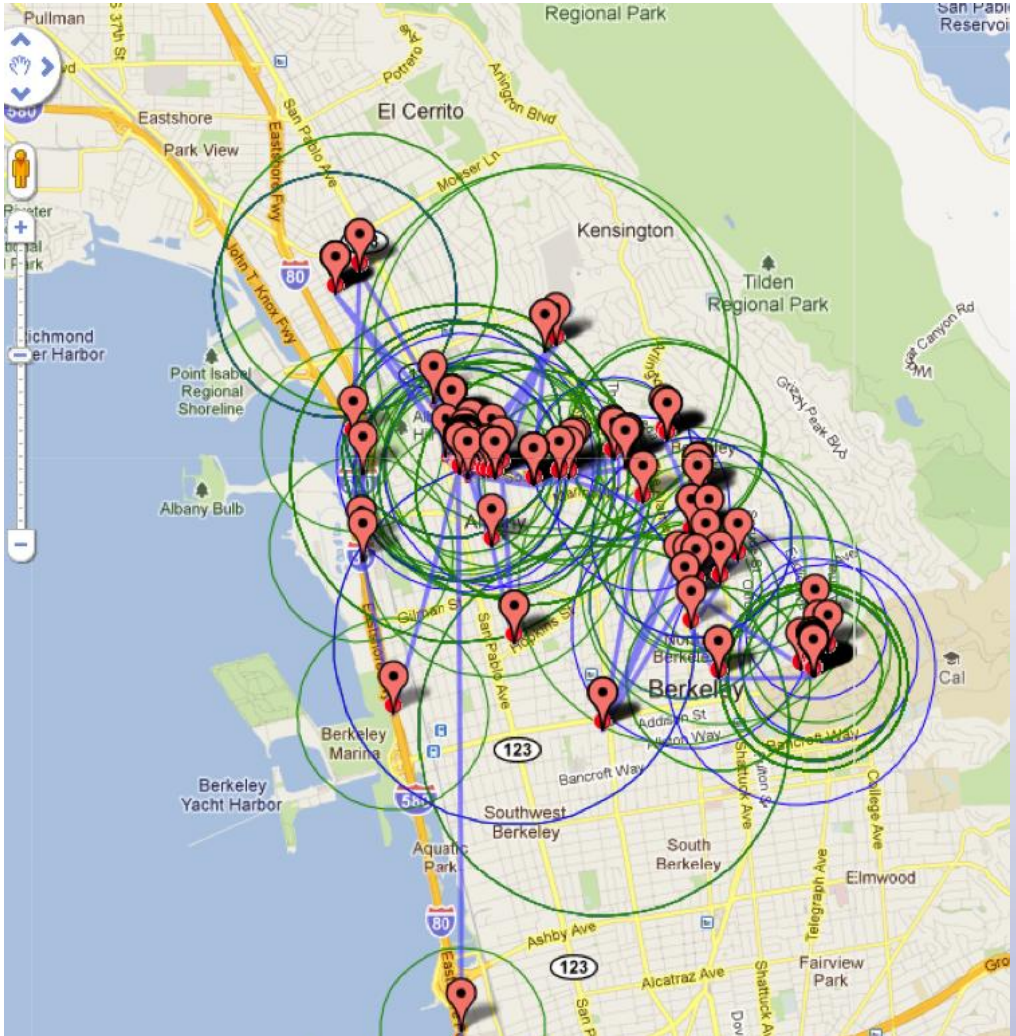
Sparseness of Data

Example of
1 person day

371 *location* points

- GPS
- Cell tower
- Wifi

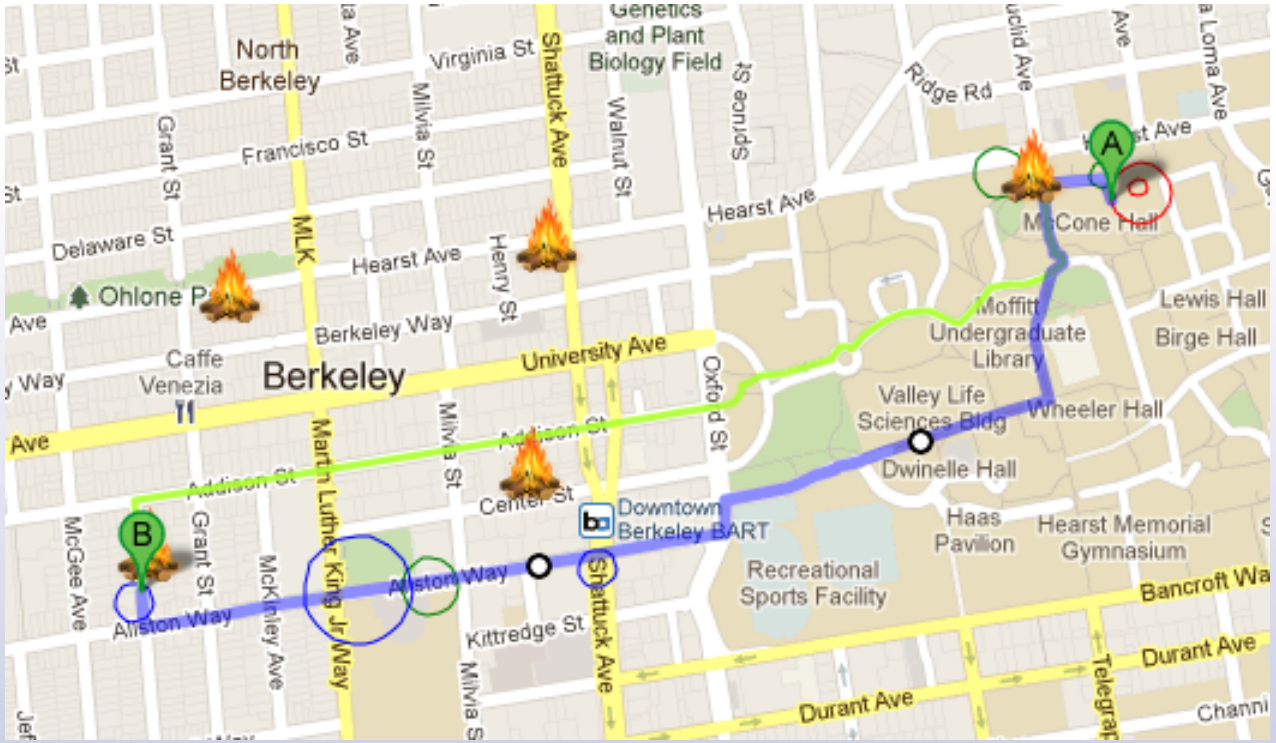
Avg 30 points/hour



Low respondent burden data collection

Sparseness of Data

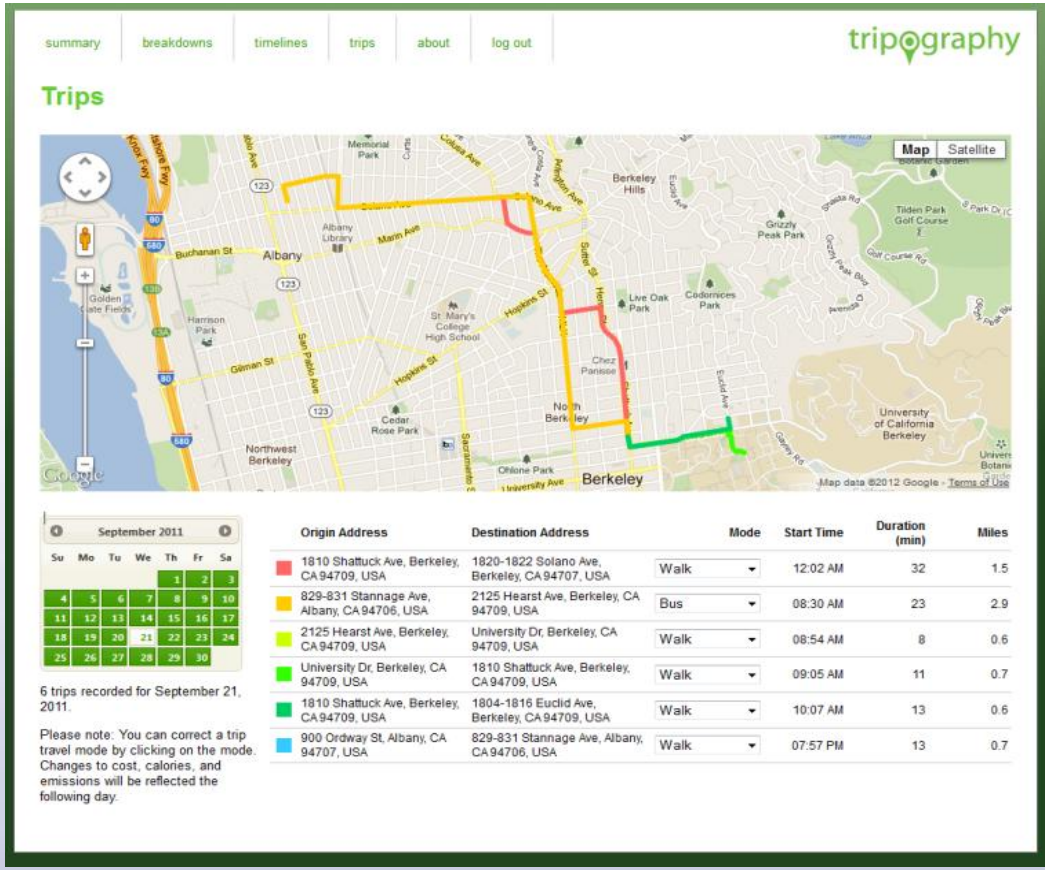
8 location points to detect this 12 minute bike trip



Low respondent burden data collection

Status

- 80+ test subjects
  45,000+ miles of travel
- Battery drain
  - 33 hour battery life
    - Average phone use
    - Net diary with
      2 hours of travel
  - 29 of 31 users
    did not notice drain



Low respondent burden data collection

Inference Algorithms

- Trips
  - Phone-based state machine (Accelerometer, WiFi beacons)
- Start/end location and start/end time
  - First guess: State machine
  - Second guess: Recalculation based on all trip traces
  - Start/end location aided by “Hotspots” (weighted clustering)
- Route
  - Filtered for accuracy, Google API
  - Removal of loops
- Mode
  - Random forest classifier on speed and trip characteristics
  - Map matching for transit

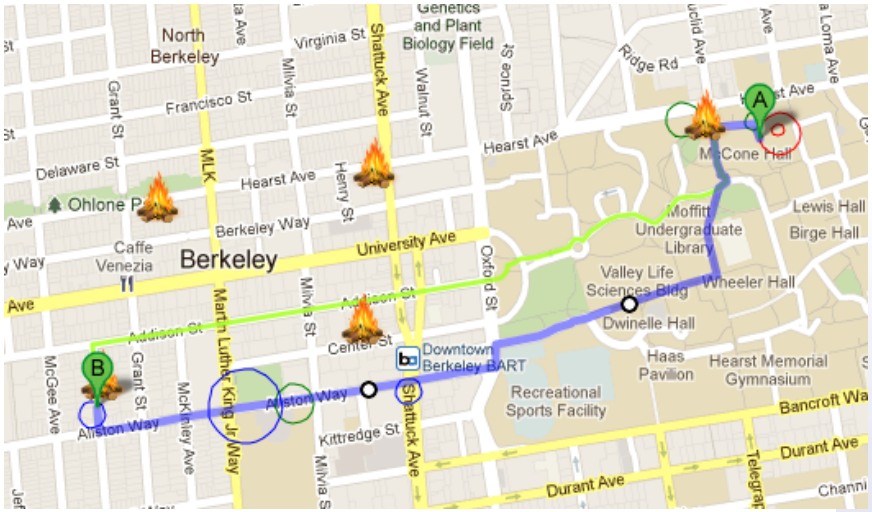
Low respondent burden data collection

Status / Accuracy

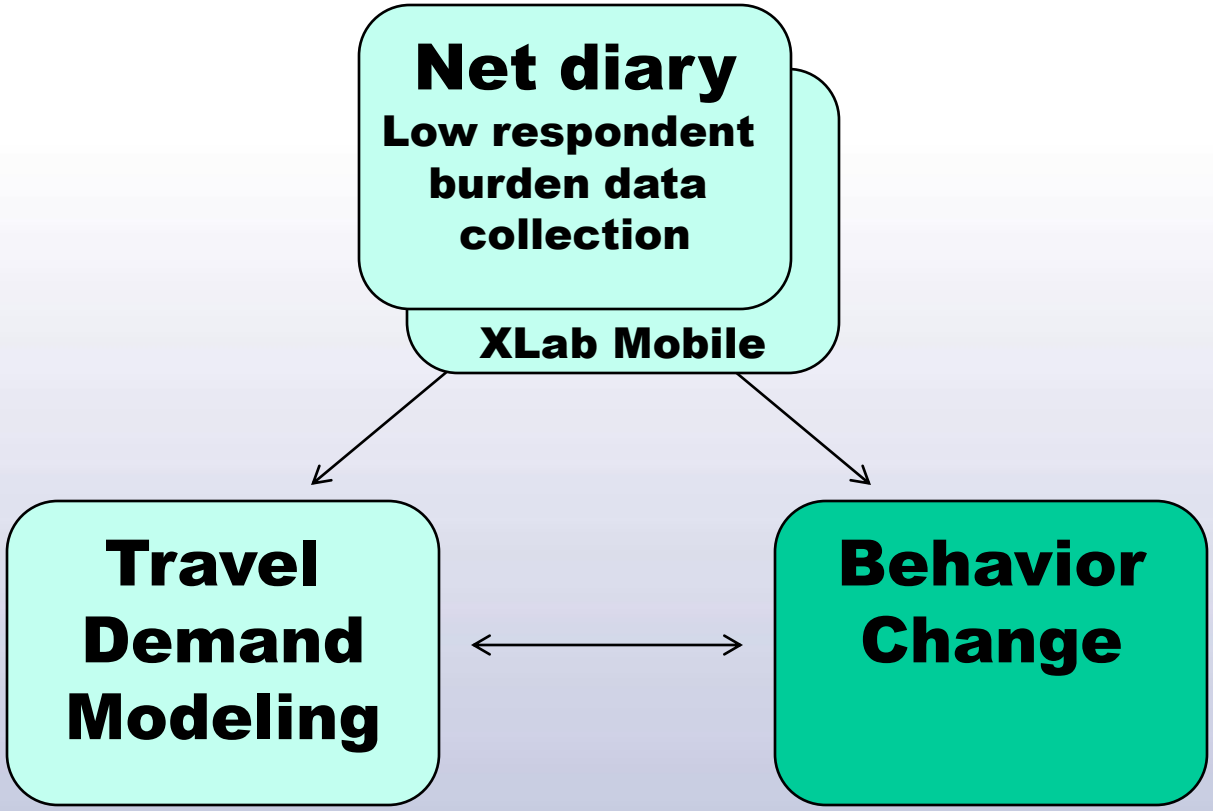
Based on 6 people, 1850 trips

- Trips: 2% missed; 2% added
- Start/end location
  - Hotspot (64% of activities)
    Avg error 25 meters
    Stdev 100 meters
  - Non-hotspot (36% of activities)
    Avg error 200 meters
    Stdev 600 meters
- Start/end time:

  84% accurate within 6 minutes
- Route
  - 94% match for drivers
  - 45% match for BART
- Mode:13.8% corrected by users

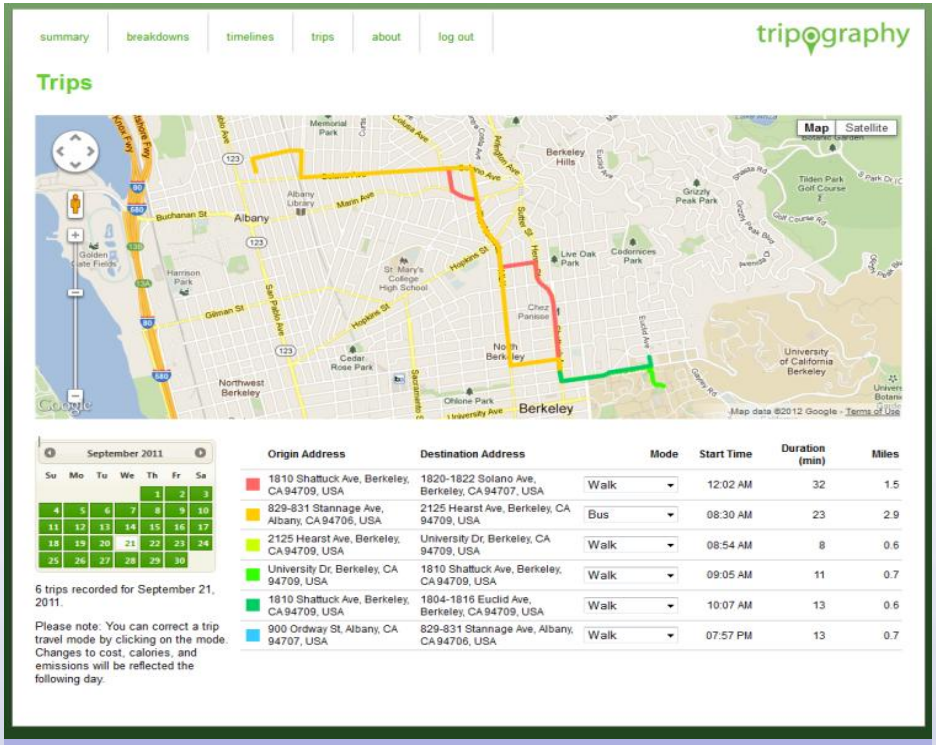


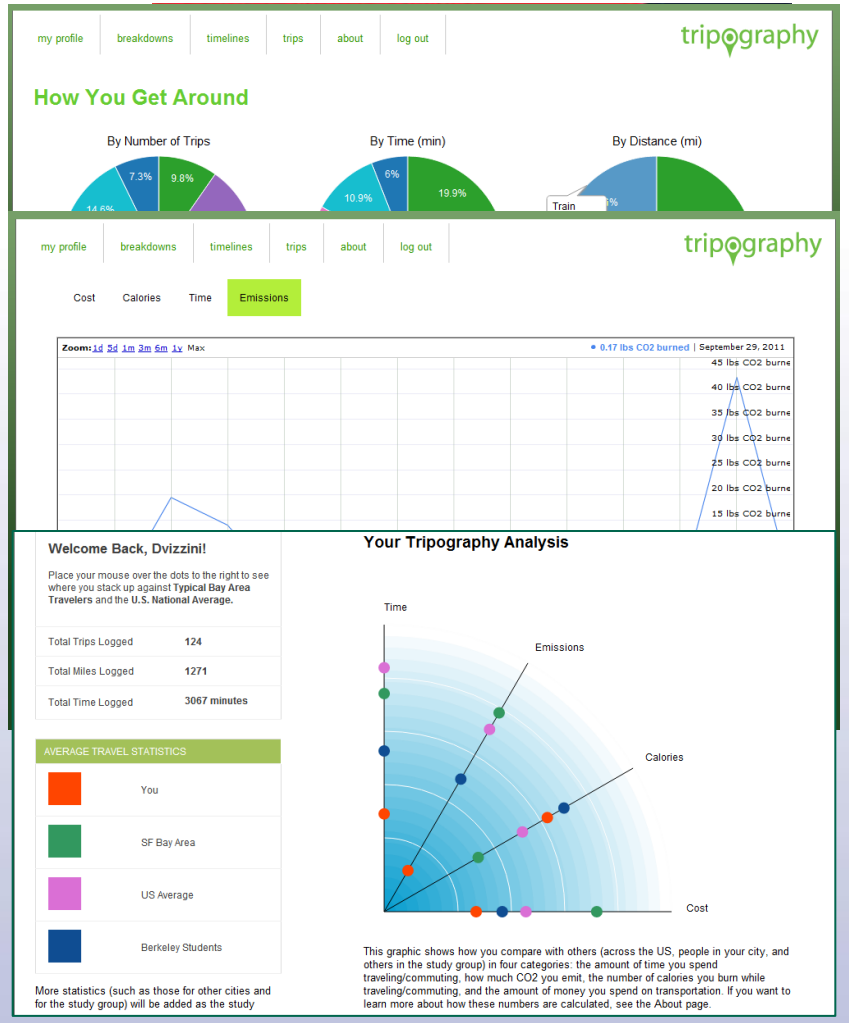
Research Agenda



Behavior Change

Quantified Traveler

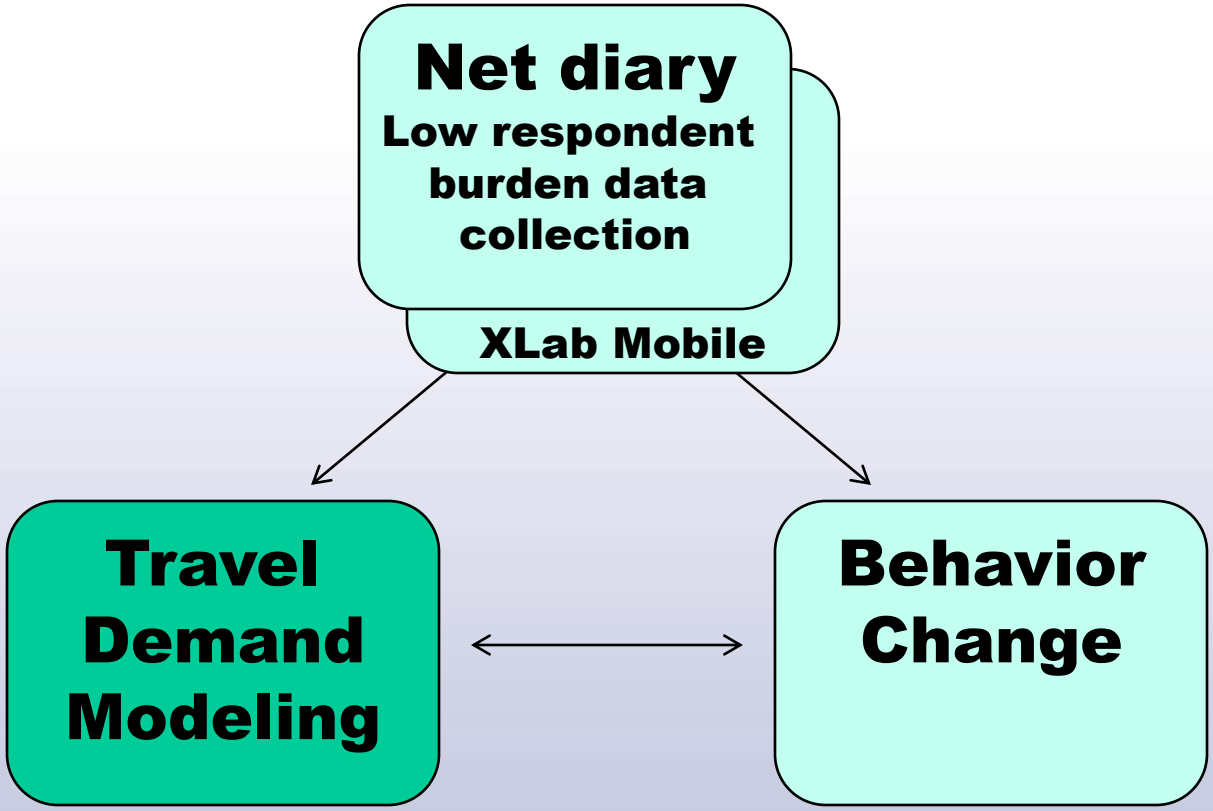




Preliminary results from 117 subjects

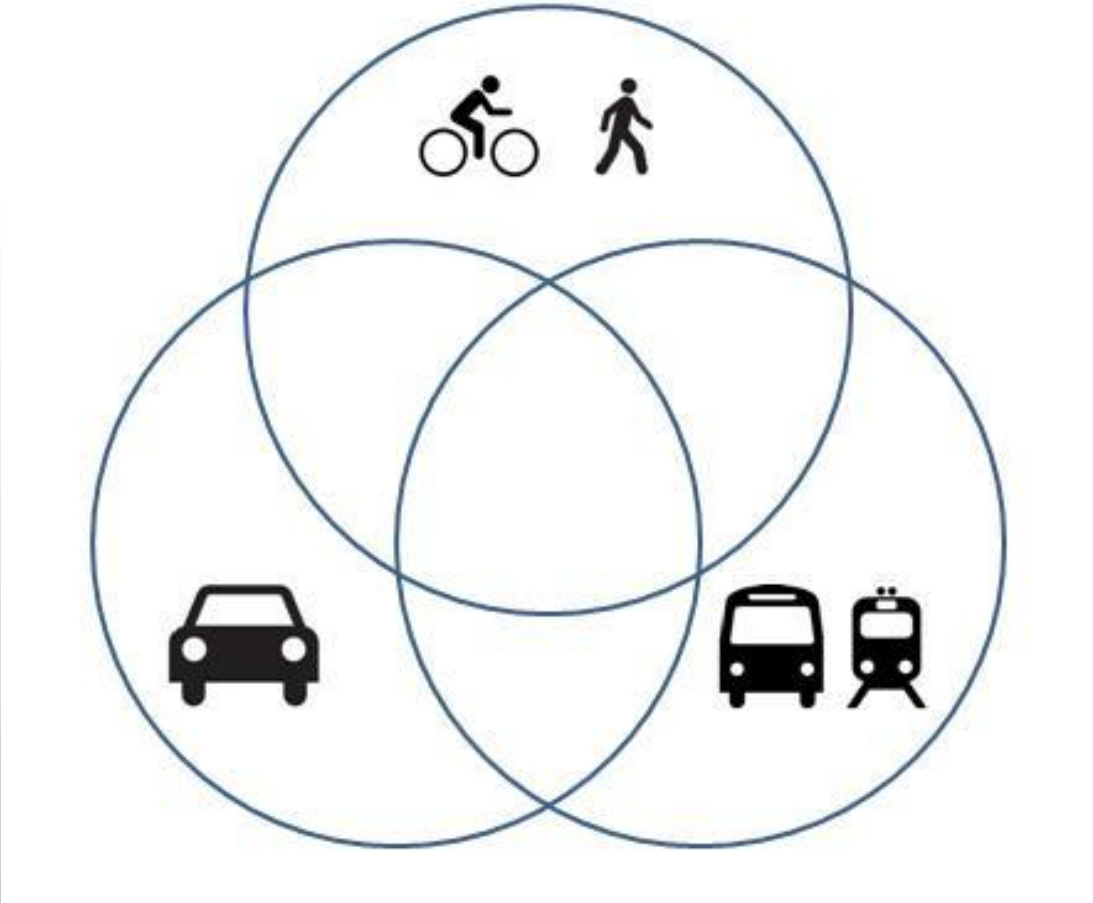
- Increase in walking (p-value 0.03)
- Decrease in driving (p-value 0.08)
- Increase in awareness (p-value 0.001)
- Increase in attitude (p-value 0.03)

Research Agenda

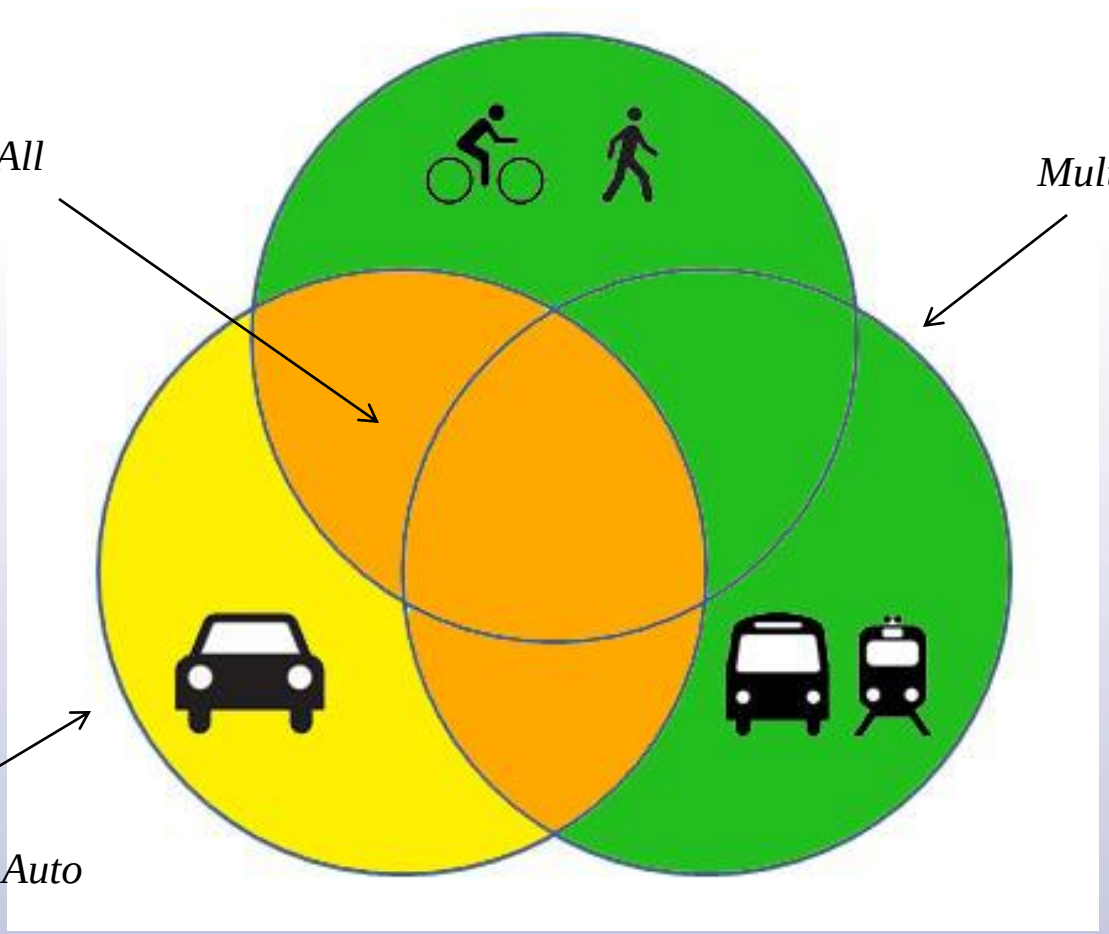


Travel Demand Modeling

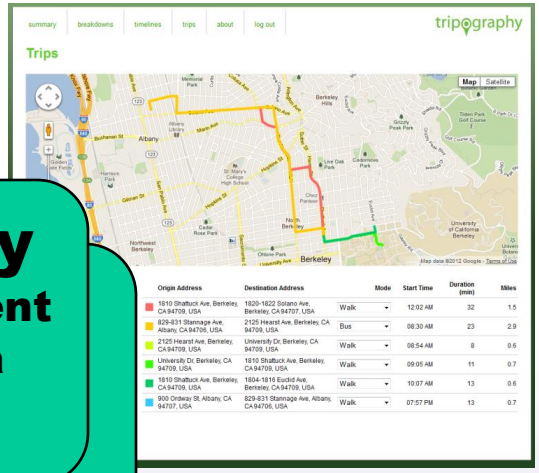
Modality Styles



Travel Demand Modeling
Modality Styles

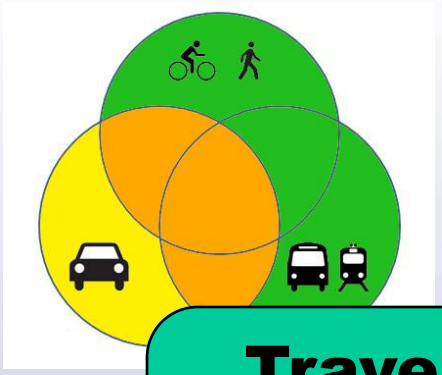


Summary



Net diary
Low respondent burden data collection

XLab Mobile



Travel Demand Modeling

Behavior Change

Thank you for your interest!

Questions, comments?